INTRODUCTION TO

# NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

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# GENERAL

**6374**

Brookhaven National Lab.

QUARTERLY PROGRESS REPORT [FOR] APRIL 1–JUNE 30, 1954. (UNCLASSIFIED SECTION). 58p. (BNL-299)

Abstracts are presented for research activities being reported concurrently in the scientific journals, with appropriate journal or document reference included. The 3-bev Cosmotron proton beam was found to yield appreciably larger numbers of K mesons in nuclear emulsions than the 2.3-bev beam. A larger number of $K^+$ production events were noted than $K^-$ events, and some added information was obtained on the decay processes of this particle. Model magnet studies associated with the design of the alternating gradient synchrotron were begun. Instruments for the direct measurement of n and the field gradient were designed for these studies. Order contamination in the diffracted beams from the 200 plane of NaCl and the 111 plane of LiF was measured by a crystal spectrometer. Separation of orders at low energies were achieved, and results are presented for 0.1, 0.2, and 0.3 ev. Fractionation of N-vinylpyrollidone polymer prepared by $\gamma$-ray initiation was carried out, and the results show that a polymer produced in this way has a narrower molecular weight distribution. A system of semi-permeable membranes, to be used in conjunction with the clay process waste disposal pilot plant, was found to have undiminished efficiency for nitrate ion transport after 45 days exposure to high-activity Purex waste. A punched card and electric typewriter data readout have been built and tested. A special signal generator circuit has been designed for the r-f mass spectrometer described elsewhere. Several threshold detectors were used to measure the radiation levels from the Cosmotron, and a Li shield technique was used to evaluate the neutron and $\gamma$ dosages on top of the thermal column of the graphite reactor. The results of several experiments on the x-ray and neutron sensitivity of dormant barley seeds in relation to $H_2O$ content showed an increased radiosensitivity with increased $H_2O$ content for fast neutrons, whereas the opposite relationship was found for thermal neutrons. A varying degree of x-ray sensitivity was noted, a result in disagreement with that predicted by a correlation between the production of active radicals and increased $H_2O$ content. Other radiation studies include the effects of ultraviolet and x radiation on the germination of Neurospora, the x-ray sensitivity of Trillium as a function of the phase of cell division, and the effects of x radiation on the liver glycogen content of rats. A quantity of protein found in the urine of children suffering from nephrotic syndrome which was not soluble in 0.25N trichloroacetic acid was analyzed and found to contain mannose, galactose, and possibly fructose, but not glucose. An experiment is described which supports the supposition that 3-hydroxyanthranilic acid is an intermediate in the synthesis of niacin from tryptophen. (For preceding period see BNL-289.) (K.S.)

**6375**

Atomic Energy Project, Univ. of Rochester

QUARTERLY TECHNICAL REPORT [FOR] APRIL 1 THRU JUNE 30, 1954. Aug. 26, 1954. 41p. Contract W-7401-eng-49. (UR-348)

A satisfactory colorimetric method for the determination of Zr in $ZrOCl_2$ is described. The method is based on that of Hayes and Jones. The dye used was an Eastman Organic Chemical labeled p-dimethylaminoazophenylarsinic acid. Satisfactory results were not obtained when the recommended p-dimethylaminoazophenylarsonic acid was used. An electronically operated relay has been developed which, while primarily designed for use with sensitive mercury thermoregulators, may be employed whenever a large power boost is required of delicate or high resistance contacts. Use of a vacuum triode rather than a thyratron permits high grid circuit resistances with resultant low control current. Reliable operation has been secured with about 0.8 volt across the open control contacts, yielding a current of 0.4 microamps through the contacts on closure. An improved aerosolizer has been constructed for production of heterogeneous aerosols from either suspensions of ground insoluble materials or solutions of soluble compounds. The aerosolizer operates on the conventional aspiration principle, but uses the surface tension of the solution to draw liquid up to and into the air jet. Therefore, since no capillary is used for liquid flow, plugging difficulties have been eliminated. The system is being tested to determine performance characteristics with solutions of 10.0, 1.0, and 0.1% NaCl operating the jet above and below the liquid surface. Preliminary tests indicate that the generator will produce uniform aerosol concentrations for periods up to six hours. Particle size values of the aerosol have been found to be reproducible at each of the tested conditions. (For preceding period see UR-230.) (auth)

# BIOLOGY AND MEDICINE

**6376**

Brookhaven National Lab.

CYTOGENETIC ANALYSIS OF A SPONTANEOUS PREMEIOTIC MUTATION IN MAIZE. E. J. Dollinger and W. R. Singleton. [1954?] 4p. (BNL-1934)

Cytogenetic tests of a spontaneous premeiotic R → r mutation which occurred in maize indicate that it is an autonomous mutation for the R locus. No evidence was found for a factor, other than the R locus, as a causal agent for the mutation. The mutant behaves as a stable r allele. No evidence was found for chromosomal alteration, pollen or transmission sterility. Thus, within the limits of the tests made, it must be called a point mutation. (auth)

**6377**

Radiation Lab., Univ. of Calif., Berkeley

THE EFFECT OF THIOCTIC ACID ON THE QUANTUM EFFICIENCY OF THE HILL REACTION. D. F. Bradley and Melvin Calvin. May 19, 1954. 34p. Contract W-7405-eng-48. (UCRL-2186(rev.))

Conditions are defined under which 6-thioctic acid, 6T, increases the quantum efficiency of the Hill reaction in Scenedesmus. This increase occurs when the control rate is quinone-limited, under conditions of high light intensity, low quinone concentration, high temperature, and high algal density. When the control rate is inhibited by high concentrations of quinone or photolyzed quinone, 6T results in a further decrease in rate. Fundamental characteristics of the Hill reaction suggest that 6T either increases the rate at which water is separated into reduced and oxidized fragments (quantum conversion agent) or decreases the rate at which these fragments later recombine (hydrogen carrier or quinone diffusion). The variation of the effect with 6T concentration, incubation conditions, pH, quinone concentration, temperature, preillumination of quinone, dark contact time with quinone, light intensity, algal density, sulfhydryl poisons, plant species, and other reagents does not permit an unequivocal discrimination between the two possible mechanisms. (auth)

**6378**

Radiation Lab., Univ. of Calif., Berkeley

CHEMICAL AND PHOTOCHEMICAL REACTIONS OF THIOCTIC ACID AND RELATED DISULFIDES. Melvin Calvin. June 10, 1954. 48p. Contract W-7405-eng-48. (UCRL-2607)

The carbon cycle of photosynthesis is briefly reviewed in its entirety, and the experiments involving it which led to the implication of disulfide rupture in photosynthesis are indicated. A review of the organic, physical, and photochemistry of disulfides, with particular reference to the five-membered disulfide rings as they appear in thioctic acid, is given. (auth)

**6379**

Radiation Lab., Univ. of Calif., Berkeley

ENZYME CONCENTRATIONS IN THE BRAIN AND ADJUSTIVE BEHAVIOR-PATTERNS. David Krech, Mark R. Rosenzweig, Edward L. Bennett, and Barbara J. Krueckel. Aug. 11, 1954. 9p. Contract W-7405-eng-48. (UCRL-2673)

A close relationship between the concentration of cholinesterase in the cerebral cortex of the rat and his adjustive-behavior patterns has been shown. The visual cortex, physiologically and cytoarchitectonically different from the other areas, is demonstrated to be different in cholinesterase concentration as well. Animals separated by a purely behavior test of hypothesis-preference show decided differences in the cholinesterase activity of the cerebral cortex. (auth)

**6380**

RADIOACTIVITY IN ANIMAL THYROIDS FROM VARIOUS AREAS. Lester Van Middlesworth (Univ. of Tennessee, Memphis). Nucleonics 12, No. 9, 56-7(1954) Sept.

The thyroid glands of cattle and sheep slaughtered in Memphis, San Francisco, and Boston were found to contain significant amounts of radioactivity with a half life of approximately 8 days suggesting the presence of $I^{131}$. (C.H.)

## *RADIATION EFFECTS*

**6381**

Brookhaven National Lab.

THE EFFECTS OF LOCALIZED CATHODE RAY PARTICLE IRRADIATION OF THE HYPOPHYSIS AND WHOLE BODY X-IRRADIATION ON ADRENOCORTICOTROPHIN, GONADOTROPHIN AND THYROTROPHIN CONTENT OF THE RAT PITUITARY. G. M. Mateyko and Abraham Edelmann. New York Univ. and Brookhaven National Lab. [1954?] 35p. (BNL-1939)

**6382**

School of Aviation Medicine

SOME EFFECTS OF A LETHAL DOSE OF X-RADIATION UPON MEMORY. A CASE HISTORY STUDY. (REPORT NO. 2, PROJECT NO. 21-3501-0003). Sylvan J. Kaplan, School of Aviation Medicine and George Gentry, Univ. of Texas and Air Force Radiobiology Lab. June 1954. 18p. (NP-5321)

A lethal dose of x radiation (1,000 r) does not entirely destroy the monkey's memory for a learned task. Manifestations of retention were obtained from between 8 hours following radiation until 21 hours before death. Survival time for the four monkeys studied ranged between 151 and 168 hours. (auth)

**6383**

Atomic Energy Project, Univ. of Rochester

STUDIES OF FLASH BURNS: THE INFLUENCE OF SKIN TEMPERATURE IN THE PRODUCTION OF CUTANEOUS BURNS IN SWINE. K. M. Berkley, H. E. Pearse, and T. P. Davis. Aug. 5, 1954. 59p. Contract W-7401-eng-49. (UR-338)

Results are reported from a study of the influence of ambient temperature on skin temperature of anesthetized swine and the influence of skin temperature on the production of cutaneous burns. It was concluded that control of the skin temperature is important in dose-response studies of radiant energy burns. (C.H.)

**6384**

Naval Radiological Defense Lab.

THE EFFECT OF NEUTRONS ON THYMIC AND CIRCULATING LYMPHOCYTES IN THE MOUSE. R. E. Carter and V. P. Bond, Naval Radiological Defense Lab. and Eugene P. Cronkite, Naval Medical Research Inst., Bethesda. Nov. 19, 1953. 24p. (USNRDL-443)

The biological effectiveness of a portion of the neutron spectrum from nuclear test devices, compared with that of x radiation, was determined using decrease in thymic weight and decrease in the lymphocyte count in the peripheral blood as the indicators of tissue damage. The neutron radiation employed was less effective in decreasing the lymphocyte count in the peripheral blood (RBE of approximately 4) than it was in producing thymic weight loss (RBE of approximately 8), indicating that ratios for neutron effectiveness can differ for similar tissues in the small mammal as well as in lower organisms used in previous experiments. It is considered that the RBE values seen in this experiment are the highest which could occur for the particular effects studied with the neutron and x radiations employed. (auth)

**6385**

Naval Radiological Defense Lab.

EFFECTS OF X IRRADIATION ON LIPID METABOLISM.

1. PLASMA PHOSPHOLIPID LEVELS IN SEVERAL SPECIES. C. Entenman, R. A. Neve, H. Supplee, and C. A. Olmsted. June 11, 1954. 28p. (USNRDL-TR-2)

Biochemical effects following x irradiation were investigated in an effort to detect early signs which are indicative of injury or are of prognostic value. It had been reported previously that in the rabbit an opalescence of the serum ascribed to lipids occurred following lethal total-body x irradiation (1000 r). The present observations confirm the occurrence of opalescence in the rabbit but indicate only rare occurrence or none at all in rats, dogs, guinea pigs, and mice. Since increased concentrations of lipid can exist in the absence of opalescence, it seemed advisable to measure plasma phospholipid phosphorus (PLP) levels as an index of lipid level. Increased concentrations of PLP were found in all species studied, which in rabbits reached exceptionally high levels during the first 24 hours. In the dog, high PLP levels are prognostic of impending mortality. The experimental data are significant in pointing up the differences among species in regard to lipid levels. The high PLP levels recall the proneness of the rabbit to develop cholesteremia and atherosclerosis. Although the PLP level may serve as a prognosis of mortality in the dog, it is not a sensitive indicator of injury since in all species lethal doses of irradiation ($LD_{50}$ to $LD_{100}$) are required to produce appreciable changes. (auth)

**6386**

Naval Radiological Defense Lab.

EFFECTS OF X IRRADIATION ON LIPID METABOLISM. 2. UPTAKE OF $P^{32}$ INTO RAT LIVER PHOSPHOLIPIDS. E. O. Weinman, S. R. Lerner, and C. Entenman. June 17, 1954. 26p. (USNRDL-TR-3)

The effect of whole-body x irradiation in the incorporation of $P^{32}$ into phospholipids of rat liver and liver cell fractions were studied both in vitro and in vivo. Liver slices from rats 24 hr after exposure to 2500 r incorporated more $P^{32}$ into phospholipids than did slices from unirradiated rats. Increased incorporation occurred in the various cell fractions studied, namely, nuclei, mitochondria, microsomes, and supernatant. No increase in $P^{32}$ incorporation into phospholipids of whole liver or cell fractions was noted in rats injected with $P^{32}$ 24 hr following irradiation with 2500 r. The significance of these results is discussed, and possible explanations are proposed. (auth)

**6387**

DOSE RECEIVED BY THERMAL NEUTRON TREATED DROSOPHILA MELANOGASTER. R. C. King (Brookhaven National Lab., Upton, N. Y.). Nucleonics 12, No. 9, 58-9 (1954) Sept.

Data on the chemical composition and neutron capture reactions of Drosophila tissue are presented from which it was concluded that the biological effects of thermal neutrons in adult Drosophila result from ionizing radiations activated by protons resulting from nitrogen capture reactions. (C.H.)

**6388**

ECONOMICS OF PORK IRRADIATION. H. J. Gomberg, S. E. Gould, J. V. Nehemias, and L. E. Brownell (Univ. of Michigan, Ann Arbor). Nucleonics 12, No. 9, 66-70(1954) Sept.

Results are presented from a cost study of a meat-processing plant designed to use $\gamma$ radiation from a $Cs^{137}$ source to irradiate hog carcasses for the purpose of breaking the trichinosis cycle in pork. (C.H.)

**6389**

HUMAN FEEDING STUDIES OF IRRADIATED FOOD TO START; ARMY TESTS WILL HASTEN COMMERCIAL APPLICATION. Nucleonics 12, No. 9, 78-9(1954) Sept.

Instigation of a feeding program is reported in which twelve volunteers will incude in their diets irradiated meat products for a period of one year. The nutritional adequacy of the meats and biological effects of consuming irradiated food will be evaluated. (C.H.)

**6390**

PRESERVING FOOD IN THE ATOMIC AGE. L. E. Brownell (Univ. of Michigan, Ann Arbor). In The Story of Our Time, New York, The Grolier Society, Inc. 1954, 3p.

Problems associated with the successful use of radiation in the sterilization of food are briefly reviewed. (C.H.)

## *RADIATION HAZARDS AND PROTECTION*

**6391**

Brookhaven National Lab.

A COMPARISON OF COMPUTED AND MEASURED GROUND-LEVEL DOSE RATES FROM RADIOARGON EMITTED BY THE BROOKHAVEN REACTOR STACK. Irving A. Singer. May 1954. 42p. (BNL-292).

The nuclear reactor at Brookhaven National Laboratory is air cooled, and consequently measurable amounts of radioargon ($A^{41}$) are emitted into the atmosphere. By a combination of theory and experimental data obtained from oil fog concentration measurements, an approximate solution to the problem of determining dose rates from the radioargon under various meteorological conditions has been obtained. The calculated values are compared with measured weekly and hourly values of $A^{41}$ at eight stations. (auth)

**6392**

Naval Medical Research Inst., Bethesda

GLUTATHIONE IN RADIATION INJURY. (LECTURE AND REVIEW SERIES NO. 54-1). Eugene P. Cronkite, Robert A. Conard, and W. H. Chapman, Naval Medical Research Inst., Bethesda and George Brecher, National Inst. of Arthritis and Metabolic Diseases, National Institutes of Health. Jan. 3, 1954. 16p. (NP-5328)

Mechanisms of the protective action of anoxia and of sulfhydryl compounds against radiation injury are reviewed. Comparative histologic changes are described which were observed in unprotected mice and in mice protected with para-aminopropiophenone and with glutathione prior to irradiation. 84 references. (C.H.)

**6393**

PERSONNEL EXPOSURES ASSOCIATED WITH THE THERAPEUTIC USE OF RADIUM, RADON, AND COBALT-60. Egilda DeAmicis and Russell F. Cowing (New England Deaconess Hosp., Boston, Mass.). New Eng. J. Med. 251, 1-4(1954) July 1.

Various methods are described which are employed in keeping the exposure of personnel handling therapeutic doses of Ra, Rn, and $Co^{60}$ below permissible exposure levels as defined by the National Bureau of Standards. (C.H.)

## *RADIOTHERAPY*

**6394**

Brookhaven National Lab.

THE EXPERIMENTAL APPLICATION OF NEUTRON CAPTURE THERAPY TO GLIOBLASTOMA MULTIFORME.

Lee E. Farr. [1954] 15p. (BNL-1947)

Preliminary results are reported in the treatment by means of neutron capture therapy of several patients with glioblastoma multiforme. Observations suggest an inhibition of tumor growth for at least four months following a single treatment. (C.H.)

**6395**

RADIOGOLD ADMINISTRATION. D. L. Tabern (Abbott Labs., North Chicago, Ill.). Nucleonics 12, No. 9, 57-8 (1954) Sept.

An improved gravity-infusion method is described by means of which an exactly calculated single dose of radiogold colloid can be administered into the pleural or peritoneal cavities. (C.H.)

## *TRACER APPLICATIONS*

**6396**

Brookhaven National Lab.

STUDIES ON THE THYROIDAL UPTAKE OF ASTATINE IN THE RAT. C. J. Shellabarger and John T. Godwin. [1954] 27p. (BNL-1924)

Astatine has been found to be selectively concentrated by the rat thyroid gland. When the thyroidal uptake of astatine was compared to the thyroidal uptake of $I^{131}$, more of the latter was taken up by the rat thyroid, although this advantage in favor of $I^{131}$ was less apparent when the period between isotope administration and sacrifice was shortened. When rats were treated with thiouracil, the thyroidal uptake of astatine was enhanced, and only in thiouracil treated thyroid glands were clusters of alpha tracks found, and these were thought to represent aggregates of astatine atoms. (auth)

**6397**

Brookhaven National Lab.

THE DETERMINATION OF EXCHANGE RATES IN THREE-COMPARTMENT STEADY-STATE CLOSED SYSTEMS THROUGH THE USE OF TRACERS. J. S. Robertson, D. C. Tosteson, and J. L. Gamble, Jr. [1954?] 15p. (BNL-1949)

A complete analysis of the behavior of tracers in three-compartment closed biological systems in the steady state is presented. A unified notation has been used to express the relationships needed to deduce the amounts and rates of exchange of the carrier in and among the compartments of the system from observation of the behavior of the tracer in only one compartment in both the series and the parallel cases. The converse problem of predicting the behavior of the tracer when the kinetics of the carrier are known is also treated in detail, with particular attention to formulas for the coefficients of the exponential terms. A symmetry in the appearance equations is noted which predicts that when a tracer is introduced into one compartment its appearance in a second is described by the same equation as obtains when the tracer is introduced into the second compartment and its appearance in the first described. The emphasis is on the practical features of the relationships between the constants which describe the behavior of the tracer and those which characterize the kinetics of the carrier; the formulas required for application of the mathematical basis of the interpretation of the behavior of tracers are given, but the details of their derivations are omitted. (auth)

**6398**

Radiation Lab., Univ. of Calif., Berkeley

PHOSPHORYLATED SUGARS. A. A Benson. June 1954. 67p. Contract W-7405-eng-48. (UCRL-2584)

Previous studies on the role of sugar phosphates in plant metabolism are reviewed, and two pathways for glucose oxidation in plant systems are presented schematically. Applications of tracer methods in the development of new analytical methods are discussed. Methods for measuring transients during sugar phosphate concentration, methods for the extraction of phosphate enters from plant material, methods for the separation of sugar phosphates, and methods for the estimation of sugar phosphates are described. 101 references. (C.H.)

**6399**

BIOLOGICAL APPLICATIONS OF TRITIUM. Roy C. Thompson (Hanford Works, Richland, Washington). Nucleonics 12, No. 9, 31-5(1954) Sept.

Applications of tritium as a hydrogen tracer in biological systems and as an ionizing-radiation source in aqueous systems are reviewed. 93 references. (C.H.)

**6400**

PULMONARY PENETRATION OF PARTICLES ADMINISTERED BY INTRATRACHEAL INSUFFLATION. Herman Cember, Theodore F. Hatch, Joseph A. Watson, and Thomas B. Grucci (Univ. of Pittsburgh, Penna.). Arch. Ind. Hyg. Occupational Med. 10, 124-9(1954) Aug.

Radadioactive barium sulfate particles were administered intratracheally to rats in order to study the pulmonary penetration and distribution of the particles. Autoradiographs made from lung sections showed that, although the particles were generally distributed in all the lobes of the lungs, the distribution was not uniform. The radioactive particles were found in irregularly shaped areas throughout all parts of the lungs. Retention data showed that about 40% of the material inside the syringe actually was deposited in the deep respiratory tract. The method of intratracheal insufflation directly through the pharynx may therefore by considered useful for the investigation of particulates in the lungs. (auth)

**6401**

SIMPLIFIED SENSITIVE TEST FOR THYROID FUNCTION, USING PROTEIN-BOUND $I^{131}$. Lester Van Middlesworth, C. E. Nurnberger, and Alys Lipscomb (Univ. of Tennessee and John Gaston Hosp., Memphis). J. Clin. Endocrinol. and Metabolism 14, 1056-61(1954) Sept.

A simplified and inexpensive method for determining the conversion ratio of $I^{131}$ in total plasma to plasma proteins is described. The method is a very sensitive means for the diagnosis of hyperthyroidism. As outlined, almost any qualified physician can utilize this diagnostic procedure without investing in special equipment such as radiation detection instruments. (auth)

**6402**

II. THE SIMULTANEOUS MEASUREMENT OF EXCHANGEABLE BODY SODIUM AND POTASSIUM UTILIZING ION EXCHANGE CHROMATOGRAPHY. Walter L. Arons, Robert J. Vanderlinde, and A. K. Solomon (Harvard Medical School and Peter Bent Brigham Hosp., Boston, Mass.). J. Clin. Invest. 33, 1001-7(1954) July.

A simple and efficient method has been presented for the simultaneous measurement of exchangeable body sodium

and potassium utilizing a cation-exchange resin for the separation of radioactive sodium and potassium in the serum in combination with the isotope dilution technique. Paired measurements made in normal subjects at intervals of one to two weeks and longer have indicated that the method presented gives reproducible results. Exchangeable body sodium and potassium measurements obtained in normal young adult subjects correspond well with data acquired by other investigators. Because of the wide range of normal values, it is suggested that body electrolyte measurements will yield the most accurate information when used in a serial fashion to study patients and that the ratio of exchangeable body sodium to exchangeable body potassium may provide a valuable index of body electrolyte composition. (auth)

**6403**

EFFECT OF RADIOACTIVE PHOSPHORUS ON TUMOR CELLS LABELED WITH THIS ELEMENT. Frederic Ludwig. Compt. rend. 239, 453-4(1954) Aug. 2. (In French).

A quantitative method for evaluating the effect of labeled compounds on the number of dead cells present in a cancer tumor is described. Doses of 15 to 50 μc of $Na_2HPO_4$ were injected into mice tumors. After a 24-hr period, 100% more dead cells were found in the serum of mice treated with the labeled phosphate than for mice injected with the nonradioactive $Na_2HPO_4$. (K.S.)

## CHEMISTRY

**6404**

Ames Lab.

THE VAPOR PRESSURE OF MERCURY AT 250-360°C. F. H. Spedding and J. L. Dye. June 23, 1954. 12p. Contract W-7405-eng-82. (ISC-495)

The vapor pressure of Hg was measured with a new-design isoteniscope in the region 250 to 360°C. The vapor pressure fits the equation $\log P = 10.59901 - 3335.027/T - 0.865372 \log T$. (auth)

**6405**

Purdue Univ.

A SURVEY OF THE THERMODYNAMIC AND PHYSICAL PROPERTIES OF WATER (thesis). Edward John Wellman. Jan. 1950. 51p. (NP-5300)

The data available concerning the constant pressure specific heat, the thermal conductivity, and the dynamic viscosity of water were surveyed. The symbols $c_p$, k, and μ are used for the three properties, respectively. These three properties were selected because from them the values of the Prandtl modulus $N_{Pr}$, a dimensionless ratio frequently used in heat transfer calculations, may be calculated. The relationship is $N_{Pr} = C_p\mu/k$. By comparing the values obtained by various investigators, those which appeared most accurate were selected, and a detailed table of the values is presented for each property. The range of the tables is from 32 to 690°F and from saturation pressure to 6000 psia. Values are listed for 10-degree temperature increments and 1000-psi pressure increments. Supplementary tables are also presented to indicate the accuracy (in each portion of the range) of the values tabulated. Accuracies were estimated from the statements of the investigators and from the magnitude of the differences noted between the several sets of data. From the tabulations of the properties, a table of Prandtl moduli was prepared by means of the equation given above. This table covers the same range of temperatures and pressures. A table of maximum errors is also presented for the Prandtl moduli. This table was prepared by combining the accuracies determined for each of the three properties. The general trends of the Prandtl moduli are discussed, and the small pressure effect in a large portion of the temperature range is pointed out. The use of the properties, including the Prandtl modulus, in the analysis of a particular heat transfer problem is discussed. (auth)

**6406**

Columbia Univ.

COLLOIDAL CHARACTERISTICS AND BEHAVIOR OF SOME FLORIDA PHOSPHATE SLIMES. PROGRESS REPORT [FOR] AUGUST 1, 1953–AUGUST 31, 1954. Victor K. La Mer, Robert H. Smellie, Jr., and Pui-Kum Lee. Aug. 31, 1954. 17p. Contract AT(30-1)-1189. (NYO-3289)

**6407**

Georgia Inst. of Tech. State Engineering Experiment Station

RESEARCH ON SURFACE PROPERTIES OF FINE PARTICLES. QUARTERLY REPORT NO. 4. (SEMIFINAL REPORT), APRIL 30, 1951–APRIL 30, 1952. J. M. Dallavalle, Clyde Orr, Jr., and H. G. Blocker. 103p. Contract DA-36-039-sc-5411. (U-22870; ATI-170749)

Surface area was determined by the liquid-phase adsorption of stearic acid or by gas adsorption methods. The agreement between the two methods is very good when the surface area is less than 50 $m^2/g$. Above this limit the area contributed by walls of very small fissures is of such importance that the agreement decreases. Particle size, surface area, grain size, and a measure of catalytic activity and distortion within the crystal were determined for specially prepared and very pure Ni powders. (J.S.R.)

**6408**

Radiation Lab., Univ. of Calif., Berkeley

CHEMISTRY DIVISION QUARTERLY REPORT [FOR] MARCH, APRIL, MAY 1954. July 8, 1954. 88p. Contract W-7405-eng-48. (UCRL-2647)

Choline and a number of its analogs were irradiated with 2- to 4-Mev β and 1.3-Mev γ radiation to determine the effects of changes in the choline molecule on its radiation sensitivity. The results are tabulated. The quantum yield in the photolysis of trimethylene disulfide by ultraviolet light was determined for various conditions. Enzymatic carboxylation of ribulose diphosphate was demonstrated in a cell-free system. The effect of total-body γ irradiation on the respiratory metabolism of sodium acetate and the Na salts of enanthic acid was investigated. It is suggested that the increase in background count rate between self-light-shielded and unshielded photomultiplier tubes in coincidence circuit scintillation counting is actually a cosmic-ray background. The study of the radioactive acid-soluble compounds obtained in the tissues of C57 male mice after the intraperitoneal administration of adenine-4,6-$C^{14}$ is almost complete. The synthesis of ethyl-1-$C^{14}$ iodide, leucyl-alanine-2-$C^{14}$, 4,6-disubstituted caproic acids, and morphine and codeine glucuronides are described. Preliminary results are reported on the irradiation products of solid benzoic acid. The effect of the sudden cessation of light on the steady-state concentrations of photosynthetic intermediates was reinvestigated. Rate studies are being

made on the respiratory metabolism of labeled organic compounds. The preparation and degradation of labeled 1,5-diphenyl-2,3-pyrrolidinedione is discussed. The $\alpha$ decay scheme of $Rn^{211}$ is given. The $\alpha$ energies and the half lives of Rn isotopes obtained from the N ion bombardment of Au were determined. Decay schemes for $Np^{238}$, $Np^{240}$, $Pa^{231}$, $Am^{243}$, and $Cf^{246}$ are presented. The $\gamma$ radiations and $\gamma$-$\gamma$ coincidences in the decay of $Ac^{226}$ and $Ac^{225}-Ac^{226}$ equilibrium mixture were determined. The performance of a snapper pulse-height analyzer is discussed. An attempt is being made to identify the oxidation products of $NH_3$ in the presence of $H_2SO_4$ above 470°C and of acetanilide and chloroactanilide. (For preceding period see UCRL-2531.) (J.S.R.)

**6409**

Radiation Lab., Univ. of Calif., Livermore

ALUMINUM DECLADDING PROCEDURE BY THE VOLATILIZATION OF ALUMINUM CHLORIDE. W. W. T. Crane, G. H. Higgins, and M. S. Coops. July 13, 1954. 5p. Contract W-7405-eng-48. (UCRL-4357)

A procedure is outlined for the separation of at least 99% of the aluminum from an alloy of aluminum, provided the other constituent is not volatile as the chloride at a temperature of 550°C. (auth)

**6410**

NEW RESULTS IN PREPARATIVE HYDRIDE RESEARCH. (Neuere Ergenbnisse der Praeparativen Hydrid-Forschung). Egen Wiberg. Translated by Vera Compton from Angew. Chem. 65, 16-33(1953). 35p. (AEC-tr-1931)

This review summarizes the present status of hydride investigations. The division of hydrides into saline, metallic, and volatile is confirmed, and the gradual transition in properties between the three principal classifications are observed. 109 references. (L.T.W.)

**6411**

AN EXAMINATION OF TIN(IV) SOLUTIONS IN SULFURIC ACID. C. H. Brubaker, Jr. (Michigan State Coll., East Lansing). J. Am. Chem. Soc. 76, 4269-71(1954) Sept. 5.

Although tin(IV) is relatively insoluble in sulfuric acid solutions, spectrophotometric and electromigration studies in dilute solutions ($10^{-3}$ *f* Sn(IV)) have been carried out. Examination of the apparent extinction coefficients, at 240 m$\mu$, as a function of sulfuric acid concentration and a similar examination in perchloric acid (which is assumed to be noncomplexing) indicate that the following reactions take place: (1) $Sn^{+4} + 2SO_4^{-} \rightleftharpoons Sn(SO_4)_2$, $K_1$; (2) $Sn(SO_4)_2 + H_2SO_4 = H_2Sn(SO_4)_3$, $K_2$. K for the reaction (1) was found to be 0.14 liters$^2$/moles$^2$ and $K_2$ was found to be small. Electromigration studies were in agreement with the above reactions. At 1.5 *f* sulfuric acid the tin migrated to the cathode, but at concentrations higher than 6 *f* $H_2SO_4$ it moves very slowly to the anode. Thus it appears that in 1 *f* to nearly 3 *f* sulfuric acid the tin(IV) ion is the predominant species. At higher sulfuric acid concentrations the tin (IV) sulfate is important. The trisulfato complex is present in substantial amounts only in very concentrated sulfuric acid. (auth)

**6412**

BIS-CYCLOPENTADIENYL COMPOUNDS OF Ti, Zr, V, Nb, AND Ta. G. Wilkinson and J. M. Birmingham (Harvard Univ., Cambridge, Mass.). J. Am. Chem. Soc. 76, 4281-4 (1954) Sept. 5.

Bis-cyclopentadienyl halides of titanium, zirconium, and vanadium in the IV oxidation state, and of niobium and tantalum in the V oxidation state, have been prepared by the reaction of the anhydrous metal halides with cyclopentadienylmagnesium halides or with cyclopentadienylsodium. The properties of the halides are given, and the preparation of the ions $(C_5H_5)_2Ti^+$ and $(C_5H_5)_2V^+$ by reduction of the IV valent titanium and vanadium compounds in aqueous solution is described. The electronic structure of the derivatives is discussed briefly. (auth)

**6413**

PARTIAL MOLAL VOLUMES AND MOLAR REFRACTIONS OF THE SYSTEM BROMINE TRIFLUORIDE–BROMINE PENTAFLUORIDE. Lawrence Stein, Richard C. Vogel, and Walter H. Ludewig (Argonne National Lab., Lemont, Ill.). J. Am. Chem. Soc. 76, 4287-9(1954) Sept. 5.

The refractive indices and densities of the system bromine trifluoride–bromine pentafluoride have been measured at 25°. Equations have been derived which express refractive index and density as functions of composition. The partial molal volumes are smaller than the molar volumes of the pure compounds, but the volume contraction upon mixing is always less than one per cent. The Lorentz-Lorenz molar refraction of the trifluoride is 13.22 cc and that of the pentafluoride is 15.41 cc. The maximum deviation of the molar refraction from that of an ideal solution is –0.06 cc. (auth)

**6414**

STUDIES IN LOW CONCENTRATION CHEMISTRY. IX. SOME INVESTIGATIONS ON ZINC. George K. Schweitzer and Wm. N. Bishop (Univ. of Tennessee, Knoxville). J. Am. Chem. Soc. 76, 4321-3(1954) Sept. 5. (cf. NSA 8-5191)

The radiocolloidal properties, solvent extraction, and tendency spontaneously to deposit on Pt foil of Zn in low-concentration aqueous solutions were studied using $Zn^{65}$ as a radioactive tracer. (L.T.W.)

## *ANALYTICAL PROCEDURES*

**6415**

Brookhaven National Lab.

COMPUTATION OF SOIL MOISTURE AT BROOKHAVEN NATIONAL LABORATORY. Robert M. Brown. [1954] 35p. (BNL-1942)

A method is described of computing daily top-soil moisture, where a knowledge of the temperature and precipitation is known. Results obtained over a five-year period at Brookhaven National Lab. are tabulated. The method is for general use only and is not an accurate soil measurement. Computations are easily and rapidly made and produce a useful picture of soil moisture content. (J.E.D.)

**6416**

Brookhaven National Lab.

PREPARATION OF RADIOACTIVE IRON FROM TISSUE FOR ASSAY OF ACTIVITY. J. Raymond Klein and Paul Bianchi. [1954?] 16p. (BNL-1943)

Two procedures are presented for the radiometric determination of Fe in tissue samples. The final preparation of the material is carried out in a simple cupped sample holder, thus avoiding electroplating. (C.H.)

**6417**

Pitman-Dunn Labs., Frankford Arsenal

THE POLAROGRAPHIC DETERMINATION OF COPPER, NICKEL, COBALT, MANGANESE, AND CHROMIUM IN TITANIUM ALLOYS. J. J. Mikula and M. Codell. Nov. 1953. 19p. (MR-570; AD-23421)

Accurate and fairly rapid polarographic methods for determining copper, nickel, cobalt, manganese, and chromium in Ti alloy are described. Copper, nickel, and cobalt are determined simultaneously in a pyridine–pyridinium chloride supporting electrolyte after hydrolyzing most of the titanium from a perchloric acid solution. The pH of the solution before polarographing is 5 to 5.5. Manganese is determined after bringing a dilute hydrofluoric acid solution to a pH of approximately 6.6 by the addition of barium carbonate, titanium being precipitated during the neutralization. Chromium is determined from a sodium hydroxide solution after oxidizing the chromium to the sexivalent state with ammonium persulfate and alkaline peroxide. These methods were found satisfactory for determining 0.2 to 5.0% copper, nickel, or cobalt in the presence of each other, 1 to 10% manganese, and 0.05 to 20% chromium using a sample weight of 0.1 g. (auth)

**6418**

COMPLEXOMETRIC TITRATIONS (CHELATOMETRY). 1. INTRODUCTION AND REVIEW. R. Pribil. Translated from Collection Czechoslov. Chem. Commune 18, 783-97 (1953). 13p. (AERE-Trans-11/3/5/428)

(Ethylenediamine)tetraacetic acid can be used for the determination of Mg, Zn Ni, Pb, Cd, Bi, and Al. The question of selective "masking" with KCN and "demasking" with chloral hydrate is discussed. Na diethyldithiocarbamate is used for selective precipitation before the complex formation. Some stepwise volumetric determinations are given as examples. (J.S.R.)

**6419**

THE SPECIFIC TITRATION OF ZINC AND CADMIUM WITH COMPLEXONE IN THE PRESENCE OF CERTAIN OTHER METAL IONS. H. Flaschka. Translated from Z. anal. Chem. 138, 332-7(1953). 4p. (AERE-Trans-11/3/5/439)

It is shown that zinc and cadmium in the presence of cobalt, nickel, copper, and mercury can be very accurately titrated complexometrically by converting all the metals into complex cyanides and decomposing those of zinc and cadmium with formaldehyde. It is possible to determine complexometrically by titration also calcium and magnesium or lead in the same sample. Interference with the estimation by other metals, its removal, and the possibilities of using the procedure for the analysis of alloys and other materials were discussed. (auth)

**6420**

PHOTOMETRIC DETERMINATION OF URANIUM IN THORIUM. Louis Silverman and Lavada Moudy (North American Aviation, Inc., Downey, Calif.). Nucleonics 12, No. 9, 60-2(1954) Sept.

The procedure described for the spectrophotometric determination of U in Th alloys and salts uses a nonaqueous solvent which not only concentrates the U into a smaller volume but reduces interference due to Th to about 1% of the U content. (C.H.)

**6421**

THE ABSORPTIOMETRIC DETERMINATION OF TRACES OF COPPER IN HIGHLY PURIFIED WATER. E. N. Jenkins (Atomic Energy Research Establishment, Harwell, Berks, England). Analyst 79, 209-16(1954) Apr.

A method is described for the determination of copper in highly purified water at the low levels significant in aluminium corrosion. Traces of copper down to 0.001 ppm can be measured absorptiometrically as cupric diethyldithiocarbamate after a single extraction from a 500-ml sample into 10 ml of chloroform in the presence of a citrate buffer and disodium ethylenediaminetetraacetic acid. No interference results from the presence of 1 ppm of common cations or of the sulphide or cyanide anions. A simple modification is described to obviate the interference of bismuth and antimony. (auth)

## *DEUTERIUM AND DEUTERIUM COMPOUNDS*

**6422**

Polytechnic Inst. of Brooklyn

FINAL REPORT COVERING THE PERIOD OCTOBER 1, 1948 TO SEPTEMBER 30, 1949. Benjamin Post, William Senett, and Leopold May. 15p. Contract N6onr-26310. (U-8049; ATI-206230)

A broad general review of the "Deuterium Project" aims and accomplishments is reported. Specific details of the overvoltage cell used for copper are given. Very recent experimental data on deuterium overvoltage at mercury in heavy water are summarized. (auth)

## *MOLECULAR STRUCTURE*

**6423**

GEL FORMATION AND MOLECULAR WEIGHT DISTRIBUTION IN LONG-CHAIN POLYMERS. A. Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A222, 542-57(1954) Mar.

In long-chain polymers an insoluble network or gel may be produced when a number of the separate molecules are linked together. A theoretical derivation is given of the relationship between the amount of gel formed and the degree of cross-linking, in terms of the initial molecular weight distribution. It is shown that whatever the initial molecular weight distribution, incipient gelling occurs when there is on the average one cross-linked monomer per weight average molecule. The shape of the gel-cross-linking curve depends on the ratio of z average, z + 1, ... average molecular weight to the weight average. From experimental values of the curve it becomes possible to determine many of the constants of the molecular weight distribution in the original polymer. Expressions are derived for the number average, weight average and z average of the polymer as a function of cross-linking prior to gel formation, as well as the number and weight averages of the sol fraction after gelation. The average molecular weight between cross-links in the gel is calculated. A number of other functions of the sol and gel fractions are also given. (auth)

## *RADIATION CHEMISTRY*

**6424**

Brookhaven National Lab.

RADIOACTIVE ANTHRACENE-$C^{14}$ AND ACRIDINE-$C^{14}$ FROM THE NEUTRON IRRADIATION OF ACRIDINE. Alfred P. Wolf and R. Christian Anderson. [1954] 20p. (BNL-1951)

Anthracene-$C^{14}$ was produced by neutron irradiation of the nitrogen homolog, acridine. The recoiling $C^{14}$ entities produced by the $N^{14}(n,p)C^{14}$ reaction were also found in acridine molecules, where the nitrogen had not undergone neutron capture during the course of irradiation. The ratio of activity as acridine to the activity as anthracene was about 19 to 1. Of the total activity produced in the samples,

3.5% was found as acridine, and 0.2% was found as anthracene. (auth)

**6425**

[Atomic Energy Research Establishment, Harwell, Berks (England)]
ADDITIVITY OF CHEMICAL EFFECTS OF HIGH ENERGY RADIATION. J. Wright. [nd] 4p. (NP-5324)

**6426**

Rensselaer Polytechnic Inst.
DECOMPOSITION OF CARBON DIOXIDE BY IONIZING RADIATION. SEMI-ANNUAL REPORT. A. J. Hogan. Apr. 1, 1954. 28p. Contract AT(30-3)-52. (SO-3255)

The decomposition of carbon dioxide and a mixture of carbon dioxide and nitrogen dioxide by irradiation with the beta particles from $Sr^{90} + Y^{90}$ at room temperature has been studied. The fact that irradiation of pure $CO_2$ produces only a very small amount of CO and $O_2$ due to the rapid reoxidation of CO to $CO_2$ is confirmed. When about 0.2% nitrogen dioxide is introduced, however, the rate of formation of CO and $O_2$ is about five times faster initially and is constant with time as long as the nitrogen dioxide concentration remains the same. About three molecules of CO per ion pair are formed. As the nitrogen dioxide is decomposed by the beta particles upon long irradiation, the yield of CO decreases. Beta source and the apparatus used for the irradiation of the gases, measurement of the ion current, and analysis of the gases are also described. (auth)

**6427**

THE PILE IRRADIATION OF POLYETHYLENE. Malcolm Dole, C. D. Keeling, and D. G. Rose (Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc. 76, 4304-11(1954) Sept. 5.

Polyethylene in the form of films and granules was irradiated in the heavy water pile of the Argonne National Laboratory, both in a vacuum and in the presence of air. The composition of the evolved gas, stress-strain relations, and tensile strength were determined for one period of irradiation. Bromine absorption, infrared absorption spectra, extent of gel formation, and viscosity of solutions were measured as a function of the duration of irradiation. The most detailed studies were made of the vacuum-irradiated samples. The first noticeable change in the composition of the film was the disappearance of the vinylidene group as hydrogen was evolved. This decrease in unsaturation was more than compensated for by the formation of the vinylene group. The bromine absorption studies demonstrated that 70 to 80% of the hydrogen evolution produced unsaturation, the remaining 20 to 30% cross linkages. From the composition of the evolved gas, it was estimated that C–C bonds along the side chains were ruptured about half as frequently as C–H bonds, but much more frequently than C–C bonds along the main hydrocarbon chain. The viscosity average molecular weight of the soluble fraction at first increased slightly, but then decreased to one third its original value. The cross-linking produced marked changes in the stress-strain characteristics without, however, greatly affecting the tensile strength when the irradiation was carried out in a vacuum. A postulate of long range migration of chemically active centers is proposed to explain the initial rapid decrease in the vinylidene concentration. (auth)

**6428**

GAMMA-RAY INDUCED OXIDATION OF AQUEOUS FORMIC ACID–OXYGEN SOLUTIONS. EFFECT OF OXYGEN AND FORMIC ACID CONCENTRATIONS. Edwin J. Hart (Argonne National Lab., Lemont, Ill.). J. Am. Chem. Soc. 76, 4312-15(1954) Sept. 5.

Radiation yields of carbon dioxide, hydrogen, and hydrogen peroxide formed and oxygen reacted have been measured over the formic acid concentration range 0.0001 to 1.0M and the oxygen concentration range 0.005 to 1.2mM. In the range 0.005 to 0.05M formic acid, the reaction kinetics are fairly simple, and a ratio of rate constants of 540 for $k_{(H + O_2)}/k_{(H + HCOOH)}$ is found. At higher formic acid concentrations there is evidence that formic acid is competing with water for the capture of electrons ejected from the water. The results are interpreted in terms of radical pair and molecular product yields of the $\gamma$ rays. (auth)

## *SEPARATION PROCEDURES*

**6429**

Carbide and Carbon Chemicals Co. (K-25)
RESULTS OF EFFICIENCY TESTS PERFORMED ON A MULTI-RANGE WIRE-MESH ENTRAINMENT SEPARATOR. R. G. Trehearne and J. E. Baker. Sept. 16, 1954. 16p. Contract W-7405-eng-26. (K-1158)

A liquid entrainment separator designed for extremely high efficiency over wide ranges of vapor flow and entrainment load has been designed, built, and tested. The tests were conducted in a natural-circulation Freon-114 evaporative cooling loop and show the efficiency of this separator to be approximately 99% over most of the operating range. (auth)

**6430**

LET'S LOOK AT SELECTIVE ADSORPTION. George Karnofsky (Blaw-Knox Co, Pittsburgh, Penna.). Chem. Eng. 61, No. 9, 189-92(1954) Sept.

A brief review of the use and means by which selective adsorption can be used for liquid-phase separations is presented, including chromatographic adsorption, ion exclusion, ion separation, and continuous countercurrent methods. The elimination of excessive dilution, the zone adsorption-elution cycle operation, designing, and how to equip for continuous countercurrency are discussed. (J.A.G.)

**6431**

LIQUID-LIQUID EXTRACTION. PART VII. FLOODING RATES AND MASS TRANSFER DATA FOR ROTARY ANNULAR COLUMNS. J. D. Thornton and H. R. C. Pratt (Atomic Energy Research Establishment, Harwell, Berks, England). Trans. Inst. Chem. Engrs. (London) 31, No. 4, 289-306(1953).

Flooding data were obtained for three rotary annular columns with diameters from 2 to 6 in. and annuli from 0.25 to 1.56 in., using five solvent–water systems. The effect of an undistributed organic solute [acetone] upon the flooding point was also investigated. It was found that the total throughput increased 200 to 300% when the transfer took place from the solvent to the water phase compared with that in the absence of solute but was reduced by about 10% when the transfer took place in the opposite direction. Equations have been derived by means of which the phase flow rates at flooding for a given system and contactor can be correlated. Mass transfer rates were determined in the same columns for the systems water–toluene and water–butyl acetate using acetone as solute, and it has been found that the major resistance to mass transfer lies in the dispersed phase film. The application of these results to the

problem of design is discussed, and a tentative method is proposed for the design of equipment of this type. (auth)

**6432**

LIQUID-LIQUID EXTRACTION. PART VIII. THE EXTRACTION OF URANYL NITRATE IN A WETTED WALL COLUMN. R. Murdoch and H. R. C. Pratt (Atomic Energy Research Establishment, Harwell, Berks, England). Trans. Inst. Chem. Engrs. (London) 31, No. 4, 307-26(1953).

Experiments have been carried out with a wetted-wall column to determine the rates of transfer of uranyl nitrate between water and two typical solvents, methyl iso-butyl ketone [M.I.K.] and dibutoxy diethyl ether [D.B.C.] over a range of concentrations. An attempt is made to interpret the over-all mass transfer coefficient in terms of the phase velocities and the interfacial resistance. It was found that the two film resistances are of the same order of magnitude, while the interfacial resistance is 10 to 35% of the over-all for M.I.K. and 5 to 20% for D.B.C. The relative value of the latter increases with flow rate owing to the diminishing diffusional resistances. The solvent film coefficients for the present system and those for the systems acetic acid–M.I.K.–water and phenol–kerosene–water have been well correlated. Values of the reaction velocity constants have been calculated from the interfacial resistance. The mass transfer coefficients for the aqueous film varied inversely as the concentration, suggesting that the transfer through this film is a pseudo-third order process. On this assumption the data for this film appear to correlate satisfactorily with data for the system acetic acid–M.I.K.–water. Possible reasons for this result are discussed briefly. (auth)

## *SPECTROSCOPY*

**6433**

Radiation Lab., Univ. of Calif., Berkeley

THE ABSORPTION SPECTRA OF SUSPENSIONS OF LIVING MICRO-ORGANISMS. K. Shibata, A. A. Benson, and Melvin Calvin. June 1954. 31p. Contract W-7405-Eng-48. (UCRL-2635)

A new method is described for obtaining sharp absorption spectra from suspensions of micro-organisms. The principle of this technique is to measure the total absorbance of the suspensions by attaching opalescent plates to cuvettes for both solvent and suspension. It must be emphasized that this technique does not involve any treatment of the suspension of any change of the optical system of the spectrophotometer for measurement. A clear absorption spectrum of living micro-organisms can be obtained with the commonly used spectrophotometer just by attaching opalescent plates to the cuvettes. Application of the method to other translucent materials such as suspensions of blood and crystals and a piece of leaf or petal have been shown. (auth)

## *TRANSURANIC ELEMENTS AND COMPOUNDS*

**6434**

ISOTOPIC EXCHANGE REACTIONS OF NEPTUNIUM IONS IN SOLUTION. II. THE Np(IV)–Np(V) EXCHANGE. J. C. Sullivan, Donald Cohen, and J. C. Hindman (Argonne National Lab., Lemont, Ill.). J. Am. Chem. Soc. 76, 4275-9 (1954) Sept. 5.

The isotopic exchange reaction between Np(IV) and Np(V) has been measured in perchloric acid as a function of hydrogen ion concentration, metal ion concentration, ionic strength, and temperature. The complex hydrogen ion dependence of the exchange rate was resolved into two regions of constant hydrogen ion dependence. In each region metal ion orders and heats of activation were determined. The over-all rate equation may be expressed as $R = k_1[NpO_2^+][H^+] + k_2[Np^{+4}]^{1.5}[NpO_2^+]^{0.5}[H^+]^{-2}$. At $\mu = 1.2$ and 25°, for the high acid path $k_1 = 6.61 \times 10^{-4}$ $l^2/mole^2/min$, $\Delta F^* = 24.2$ kcal/mole, $\Delta H^* = 17.6$ kcal/mole and $\Delta S^* = -22.2$ cal/deg/mole. At $\mu = 1.2$ and 25°, for the low acid path, $k_2 = 3.87 \times 10^{-6}$ mole/liter/min, $\Delta F^* = 27.2$ kcal, $\Delta H^* = 36.8$ kcal, $\Delta S^* = 32.2$ cal/deg/mole. (auth)

## *URANIUM AND URANIUM COMPOUNDS*

**6435**

Brookhaven National Lab.

LOW TEMPERATURE MOBILITY OF HYDROGEN IN URANIUM HYDRIDE. EXCHANGE EQUILIBRIUM OF DEUTERIUM BETWEEN HYDROGEN AND URANIUM HYDRIDE. Jacob Bigeleisen and Arthur Kant. [1953] 16p. (BNL-1916)

It is shown that $UH_3(s)$ and $D_2$ undergo rapid isotopic exchange at and below room temperature. The reaction is diffusion controlled in the solid. The equilibrium constant for the reaction $UH_3(s) + HD(g) = UH_2D(s) + H_2(g)$ has been measured between 195 and 433°K. The difference in enthalpies between $UH_3$ and $UH_2D$ is found to be 1186 cal/mole at 200°K. The calculated entropy change for the reaction at 200°K is in good agreement with experiment. A discussion is presented to show why the ratio of the dissociation pressures of $UH_3$ and $UD_3$ is independent of temperature between 530 and 700°K. (auth)

**6436**

ON SOME SELENIUM AND TELLURIUM COMPOUNDS OF URANIUM. Riccardo Ferro. Translated from Z. anorg. u. allgem. Chem. 275, 320-6(1954). 6p. (AERE-Trans-11/3/5/440)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 8-3716.

**6437**

PHASE EQUILIBRIA OF URANIUM TRIOXIDE AND AQUEOUS HYDROFLUORIC ACID IN STOICHIOMETRIC CONCENTRATIONS. William L. Marshall, J. S. Gill, and C. H. Secoy (Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc. 76, 4279-81(1954) Sept. 5.

A phase study of the liquid-solid equilibria for aqueous solutions containing two moles of hydrofluoric acid per mole of uranium trioxide from the ice eutectic at −13° to the critical temperature of the saturated liquid at 377° is presented. Some observations on vapor-liquid equilibria are included, and their significance is discussed. The system displays three solid phases of uranyl fluoride hydrates stable with respect to the saturated solution in the temperature ranges −13 to 150°, 150 to 240°, and above 240°, respectively. There is some evidence to indicate that these solids are all allotropic modifications of uranyl fluoride dihydrate, but this is not certain. In the dilute region at temperatures above approximately 200° a solid phase appears which is apparently a solid solution between $UO_2(OH)_2$ and $UO_2(OH)F \cdot \frac{1}{2} H_2O$. A two-liquid phase region occurs from approximately 23 to 66 weight per cent uranium trioxide. The critical solution temperature of the two-liquid phase region is 320° while the upper limit is the temperature of the invariant system solid-liquid I-liquid II-

vapor, at 333°. The vapor-liquid critical temperature of the water-rich liquid phase saturated with respect to the high temperature solid is 376°, thus indicating a significant but small solubility in the critical fluid. (auth)

**6438**

A COUNTER-CURRENT MICRO-ROTARY EXTRACTOR AS AN ANALYTICAL TOOL. R. Spence and R. J. W. Streeton (Atomic Energy Research Establishment, Harwell, Berks, England). Analyst 77, 578-83(1952) Nov.

A micro form of rotary solvent extractor is described. Quantitative extraction of uranium has been attained with columns from 10 to 15 cm in length, both on a continuous basis and from samples of one or two ml. (auth)

### *WASTE DISPOSAL*

**6439**

Brookhaven National Lab.

RADIOACTIVE WASTE DISPOSAL AND CONTROL PROGRAMS AT BROOKHAVEN NATIONAL LABORATORY. Lee Gemmell. [1954]. 5p. (BNL-1937)

## ENGINEERING

**6440**

A FURTHER STUDY OF THE HYDRAULIC CYCLONE. D. F. Kelsall (Atomic Energy Research Establishment, Harwell, Berks, England). Chem. Eng. Sci. 2, 254-72(1953) Dec.

By a technique involving injection of closely sized batches of Perspex spheres into the feed of a 3-in. hydraulic cyclone, the effect of several variables on solid elimination efficiency investigated. A ¼ in. feed diameter results in maximum efficiencies on this cyclone for a wide range of conditions. It is considered impossible to derive simple power relationships to describe the effect on particle elimination efficiency of change in feed diameter, overflow diameter and throughput, to cover a range including the optimum conditions. The importance of turbulent mixing in the feed section due to shock effects and of the short circuit flow down the outside wall of the vortex finder were demonstrated. (auth)

### *HEAT TRANSFER AND FLUID FLOW*

**6441**

REPRESENTATION OF GAS CURRENTS BY MEANS OF ELECTRON BEAMS. B. Schumacher. Translated from Ann. Physik 13, 404-20(1953). 31p. (AEC-tr-1947)

It is shown that gas currents to which light interferometers no longer respond because of insufficient thickness of layer can be visualized skiagraphically by means of electrons and that in this process a high geometric resolving power is achieved despite the scattering of the electrons in the gas. The gas density of the stream can be determined from the image if certain turbidity functions are known; these have been measured and are indicated for a number of cases. (auth)

### *MATERIALS TESTING*

**6442**

CREEP TESTS OF ROTATING DISKS AT ELEVATED TEMPERATURE AND COMPARISON WITH THEORY. A. M. Wahl, G. O. Sankey, M. J. Manjoine, and E. Shoemaker (Westinghouse Research Labs., East Pittsburgh, Penna.). J. Appl. Mechanics 21, 225-35(1954) Sept.

A theoretical and experimental program involving methods of calculating creep in rotating disks at elevated temperatures is described. This program consisted primarily of the following: (a) Obtaining forged disks from the same ingot of 12 per cent chrome steel, all disks being forged and heat-treated in the same manner; (b) making spin tests at 1000°F on three of these disks for periods up to about 1000 hr; (c) making long-time tension-creep tests at 1000°F on many specimens cut out circumferentially from several of the other disks at stresses approximating those of the spin tests; (d) investigating theoretical methods of calculation of creep deformation in such disks; and (e) comparison of spin-test results with those calculated theoretically using average tension-creep data. It was found that available methods of calculating rotating disks based on the Mises criterion gave creep deformations too low compared to the test values, i.e., on the unsafe side for design. Considerably better agreement between test and theoretical results is obtained if the latter is based on the maximum-shear theory. Some discussion is given of the reasons for the better agreement obtained using the latter theory; these are believed to be related in part to the anisotropy of the forged material tested. Further tests on other materials are necessary before general conclusions can be drawn; however, in the absence of test data it is suggested that a conservative course in design for such disks is to apply the maximum-shear theory. (auth)

## MINERALOGY, METALLURGY, AND CERAMICS

### *CERAMICS AND REFRACTORIES*

**6443**

National Bureau of Standards

PHYSICAL CHARACTERISTICS IN TITANIUM-CARBIDE-BASE CERMETS AT ELEVATED TEMPERATURES. Friedrich P. Knudsen, R. Eugene Moreland, and Roman F. Geller. May 1954. 78p. Contract AF 33(616)52-2. (WADC-TR-54-1)

The creep behavior and strength of cermets which may find application in the high-temperature areas of aircraft were determined at 1200 to 2000°F. Initially a series of bending tests were made on variations of Kennametal's composition K151A. The variations contained from 5 to 30% nickel bonding. The 5, 15, and 20% compositions were recommended, on the basis of their creep resistance and high strength, for further long-term tensile creep tests. A limited number of tensile creep tests were made on Kennametal's compositions K151A–20% nickel, K151A–25% nickel, K152A, K162B, and on Firth Sterling's composition, FS-27. The cermet K162B was deemed the most promising of the tested compositions with respect to the properties of creep resistance and high strength. Metallographic examinations were made of all the tensile tested specimens, and, in general, the test strains had been too small to cause any noticeable deformation or changes. Thermal expansion determinations were made on Kennametal's compositions K138, K138A, K151, and K151A.

The coefficients of expansion between room temperature and 1205°C ranged from $8.1 \times 10^{-6}$ to $8.6 \times 10^{-6}$. (auth)

**6444**

PHASE EQUILIBRIUM RELATIONS IN THE SYSTEMS LIME–TITANIA AND ZIRCONIA–TITANIA. L. W. Coughanour, R. S. Roth, and V. A. DeProsse (National Bureau of Standards, Washington, D. C.). J. Research Natl. Bur. Standards 52, 37-42(1954) Jan.

The systems $CaO-TiO_2$ and $ZrO_2-TiO_2$ studied by means of solid-state reactions and by the observation of fusion characteristics. The existence of two binary compounds in the $CaO-TiO_2$ system was confirmed. One compound was found to exist in the $ZrO_2-TiO_2$ system. This compound, $ZrO_2 \cdot TiO_2$, has been found to have orthorhombic symmetry with the following parameters at room temperature: $\alpha$ = 4.806 A, b = 5.032 A, c = 5.447 A. Solid–solution development was observed in the $ZrO_2-TiO_2$ system, but not in the $CaO-TiO_2$ system. From the data obtained, an equilibrium diagram is suggested for each system. (auth)

## *CORROSION*

**6445**

Research Center, Babcock and Wilcox Co.

CORROSION TESTS FOR ARGONNE NATIONAL LABORATORY. FINAL SUMMARY REPORT. S. C. Datsko. Aug. 31, 1953. 18p. Contract [W-31-109-Eng-38], Subcontract W-31-109-38-188. (BW-5313)

The corrosion behavior of a series of structural materials in 500 and 600°F, which included zirconium and zirconium alloys, was determined. Several methods of water treatment were employed in attempting to minimize the corrosion of the materials. The detailed results of these tests were included in 40 reports issued during the course of the work and listed in the bibliography of this report which summarizes the work. (auth)

**6446**

Lewis Flight Propulsion Lab., NACA

EFFECTS OF ADDITIVES ON CORROSION AND MASS TRANSFER IN SODIUM HYDROXIDE–NICKEL SYSTEMS UNDER FREE-CONVECTION CONDITIONS. Americo F. Forestieri. May 21, 1954. 13p. (NACA-RM-E54E19)

Experiments were carried out under free-convection conditions in sodium hydroxide–"L" nickel systems. Nickel crucibles half full of sodium hydroxide were heated for 24 hours at 1500°F with a temperature difference of 45°F. The effect of additives such as metals, salts, oxides, and nitrides on the extent of corrosion and mass transfer was determined by measurement of the weight change of a specimen in the hot zone and by metallographic examination of the specimen cross section. Reduction in mass transfer occurred with additives of powdered chromium and aluminum. (NACA abst.)

**6447**

VALVES TO COMBAT CORROSION. Chem. Eng. 61, No. 9, 198-204(1954) Sept.

Seventy-five questions and answers pertaining to materials that may be used in the construction of corrosion-resistant valves are presented. (J.A.G.)

**6448**

CORROSION. Mars G. Fontana. Ind. Eng. Chem. 46, 85A-8A(1954) Sept.

The effects of aeration or dissolved $O_2$ in a liquid environment on the corrosion rates of metals and alloys are discussed. Suggested methods of aeration and deaeration by the addition of $N_2$ or A and their effects on corrosion are presented. The corrosion rate of Monel in sulfuric acid indicated an increase when saturated with $N_2$ (air free). A decrease of corrosion is shown when the boiling point is reached due to the lack of solubility of $O_2$ at this temperature. The use and advantages of mils/yr as a standard expression for corrosion rate are given. The effect of oxidizing capacity of solution on corrosion rates of stainless steel, Al, Hastelloy C, Monel, Fe, and Cu is given. (J.A.G.)

## *GEOLOGY AND MINERALOGY*

**6449**

Division of Raw Materials, AEC

URANIUM OCCURRENCES IN WILSON CREEK AREA, GILA COUNTY, ARIZONA. R. L. Wells and A. J. Rambosek. July 1954. 15p. (RME-2005(rev.))

Four claims covering concentrations of uranium mineralization in the Dripping Spring formation are located in typical plateau-type topography with flat mesas and nearly vertical canyon walls. The bedded zones of uranium mineralization are exposed in the Dripping Spring quartzite near the bottom of the canyons. It is tentatively concluded that the mineralized beds in the quartzite may bear a definite spatial relationship to the base of the overlying Mescal limestone and to the bottom of a thick zone in the upper member of the quartzite. Two of the four bedded deposits occur in beds having the appearance of being covered with minute cracks. One mineralized fracture was noted. The uranium mineral, metatorbernite, has formed in tiny vugs in the quartzite and is also intergrown with the iron oxide coating on the quartzite surfaces. Associated minerals, present in minor amounts, are chalcopyrite, magnetite, and chalcocite. (auth)

**6450**

Division of Raw Materials, AEC

URANIUM MINERALIZATION AT THE MOONEY CLAIM, SILVER BOW COUNTY, MONTANA. Wayne S. Moen. Feb. 1954. 15p. (RME-2006)

Uranium minerals associated with stibnite occur in a vein-type deposit about ten miles west of Butte, Mont. Meta-autunite, and possibly pitchblende, is disseminated throughout a brecciated quartz-stibnite vein as well as in the adjacent altered quartz monzonite. The mineralized structure is the so-called silicified reef type previously described from the Clancy, Mont., area. Diamond drilling has proven the existence of ore-grade uranium-bearing material at depth. (auth)

**6451**

Division of Raw Materials, AEC

RECONNAISSANCE FOR URANIUM IN THE HUALAPAI INDIAN RESERVATION AREA, MOHAVE AND COCONINO COUNTIES, ARIZONA. Richard D. Miller. Apr. 1954. 18p. (RME-2007)

The Hualapai Indian Reservation and contiguous areas just south of the Colorado River in northwestern Ariz. were investigated for uranium by reconnaissance methods. The rugged topography, large extent of the area within a sparsely populated Indian reservation, and absence of recent mining activity are factors which substantially contribute to lack of interest in uranium prospecting in the area. Paleozoic sediments ranging in age from Cambrian to Permian (Ordovician and Silurian missing) are exposed by deep canyons. Pre-Cambrian basement rocks consisting of

granite and metamorphic rocks underlie the sediments; Quaternary and Tertiary volcanic rocks and late Tertiary gravels overlie small areas of the Paleozoic rocks. Major faults are a conspicuous feature of the eastern part of the area. The Ridenour mine in the northeastern part of the reservation is near similar prospects north of the Colorado River. This old copper deposit in Supai sandstone contains carnotite and other vanadium minerals in the hanging wall of the mineralized vein and breccia zone of copper sulfides and carbonates. Mine workings closely follow geologic structure which appears to have controlled an ore body resembling part of a hollowed-out, truncated cone. The Permian Supai formation and the lower Hermit shale appear to be the most favorable rocks for uranium deposits localized by stratigraphic control. The proximity of known uranium occurrences to major faults indicates that the northeastern part of the reservation where faults are extensive may be a favorable area for prospecting. (auth)

**6452**

Grand Junction Operations Office, AEC
THE URANIUM DEPOSITS OF BIG INDIAN WASH, SAN JUAN COUNTY, UTAH. George P. Dix, Jr. Sept. 29, 1954. 15p. (RME-4022(rev.))

Uranium deposits in the Big Indian Wash area crop out along an escarpment which forms the westernmost limit of the wash. The deposits are exposed discontinuously through a distance of 5 miles. Two mineralized horizons are recognized: one, a coarse arkose of the Cutler formation; the other, a lower sandstone in the Chinle formation. The Cutler horizon has been mined since 1948, but the Chinle deposits have been worked only since late 1952. The Chinle horizon is continuous in the area, but the arkosic sandstones of the Cutler are lenticular and discontinuous. The Chinle formation has not been previously recognized in eastern Utah as a favorable host rock. (auth)

**6453**

VERIFICATION OF THE RADIOACTIVITY OF AFRICAN PHOSPHATES. Léon Visse. Compt. rend. 239, 545-7 (1954) Aug. 18. (In French).

A relationship between the concentration ratio U/P and the deposition conditions of sedimentary phosphates is assumed. Proofs of the subsequent displacement of the U are given. (tr-auth)

**6454**

LABORATORIES THAT MAKE FIRE ASSAYS, ANALYSES, AND TESTS OF ORES, MINERALS, METALS, AND OTHER INORGANIC SUBSTANCES. B. R. Klahold (U. S. Bureau of Mines, Washington, D. C.). U. S. Bur. Mines Inform. Circ. 7695, Aug. 1954, 20p.

Activities of Federal and State agencies from which help may be obtained in the identification of mineral samples are summarized. Procedures for obtaining mineral samples are outlined, and various testing procedures are described. Prices charged for the various tests and commercial laboratories engaged in testing are listed. (C. H.)

**6455**

EFFECT OF ASHING TEMPERATURE ON THE VOLATILITY OF GERMANIUM IN LOW-RANK COAL SAMPLES. Claude L. Waring and Wendell P. Tucker (U. S. Geological Survey, Washington, D. C.). Anal. Chem. 26, 1198-9(1954) July.

The loss of low-rank coal samples by gradual heating from 200 to 1000°C and rapid heating to 800°C was spectrographically determined. Additional determinations were made on rapidly heated samples to 1000°C in wide-mouthed containers with wide surface areas and with small surface areas exposed to air. In each case no detectable loss was indicated. (J.A.G.)

## *METALS AND METALLURGY*

**6456**

Argonne National Lab.
URANIA BODIES: FIRED DENSITY VS. PARTICLE SIZE. Fred H. Gunzel, Jr. and W. A. Lambertson. Aug. 1954. 14p. Contract W-31-109-eng-38. (ANL-5094)

Urania bodies were prepared from batches of urania powder as received and as ground for periods of 16, 56, and 140 hours. The particle size distribution of each batch was determined with a double pipet apparatus. The prepared specimens were examined under a microscope to determine relative porosity, and their densities were measured and plotted. A trend was noted whereby the density increased and porosity decreased as the particle size decreased. Calcined material yielded a body of higher density than uncalcined material of even finer particle size. (auth)

**6457**

Argonne National Lab.
URANIA–ZIRCONIUM CERMETS. FINAL REPORT. W. G. Rauch. Aug. 1954. 13p. Contract W-31-109-eng-38. (ANL-5268)

A series of uranium dioxide powder compacts with the addition of zirconium as metallic binder were produced and studied in a preliminary investigation of such materials. Techniques such as electrodeposition, infiltration, cold pressing and sintering, and hot pressing were tried. Sintering of the powder compacts was carried out in an inert gas atmosphere or vacuum depending upon pressing methods and composition. This work on $UO_2$–Zr type cermets is limited to the methods of powder compaction, some physical property data, and the exploratory study of microstructures and phase constituents, the latter by x-ray analysis. (auth)

**6458**

Lewis Flight Propulsion Lab., NACA
INVESTIGATION OF NICKEL–ALUMINUM ALLOYS CONTAINING 14 TO 34 PERCENT ALUMINUM. W. A. Maxwell and E. M. Grala. June 17, 1954. 43p. (NACA-TN-3259)

Alloys containing the intermetallics NiAl and $Ni_3Al$ were prepared by casting. The melting practice developed was most important for the preparation of sound bodies. Room- and elevated-temperature strengths, ductilities, and susceptibilities to hot rolling were determined. The 17.5-percent aluminum alloy had the most outstanding properties and was studied in greatest detail. Creep-rupture strength at 1350°F, impact resistance, thermal shock behavior, oxidation resistance, and effects of thermal treatment on microstructure were determined for the 17.5-percent aluminum alloy. (NACA abst.)

**6459**

Laboratories for Research and Development, Franklin Inst.
DEVELOPMENT OF MAGNETOSTRICTIVE AND RELATED MATERIALS. FINAL PROGRESS REPORT [FOR] APRIL 10, 1952 TO APRIL 9, 1954. Frank J. Donahoe. 65p. Contract AF 18(600)302. (NP-5319; F-2306(pt.2))

A study of the effects of the order-disorder transformation was made on alloys with compositions near $Ni_3Mn$,

$Fe_3Pt$, and $FePd_3$. In the Fe–Pd alloys, the work was extended to include measurement of saturation moment at low temperatures and of the long-range order parameter. The saturation moment of alloys near $FePd_3$ appears to be unaffected by the degree of order. The Curie temperature is strongly influenced in the early stages of ordering. It is suggested that short-range order plays the major role in affecting the Curie temperature. The kinetics of the ordering process in $Fe_3Pt$ alloys were studied at temperatures from 450 to 750°C. Resistivity measurements on polycrystalline wires were used to follow the ordering process. The results appear to confirm the general features of the phase diagram. The ordering process can be fitted to a rate law governed by $\exp -(t/\tau)^{1/2}$, with an activation energy of about 50 kcal/mole. The resistivity at the temperature is little affected by ordering. The ferromagnetic Curie temperature is strongly influenced, and through it the resistivity is quenched to 0°C. These results were confirmed by magnetic studies. As with the $FePd_3$ alloys, major changes in Curie temperature were noticed after very short anneals, and it is suggested here also that short range order is very important. Magnetostriction measurements on disordered polycrystalline specimens of the 30.0 at.% Pt alloy were made. The linear magnetostriction coefficient at room temperatures was $49.7 \times 10^{-6}$, and increased to $83.9 \times 10^{-6}$ at 80°K. (auth)

**6460**

Wisconsin Univ.

RESEARCH ON ELECTRODEPOSITION OF MOLYBDENUM ALLOYS FROM AQUEOUS SOLUTIONS. FINAL REPORT [FOR] FEBRUARY 1, 1952 TO AUGUST 31, 1954. D. W. Ernst, R. F. Amlie, and M. L. Holt. Aug. 1954. 37p. Contract DA-11-022-ORD-656. (NP-5320)

**6461**

Carnegie Inst. of Tech.

GRAIN BOUNDARY DIFFUSION IN A BODY-CENTERED CUBIC LATTICE. C. W. Haynes and R. Smoluchowski. June 10, 1954. 22p. Contract AT-35-1-GEN-359. (NYO-3491)

Oriented bicrystals of a 3% silicon–iron alloy were prepared with a common [011] direction and were used in a study of intergranular diffusion in the body-centered lattice. The penetration of iron at the grain boundary during diffusion was obtained by an autoradiographic technique. The penetration was found to be orientation dependent, with no preferential grain-boundary diffusion being observed for relative angles of disorientation below about 10°. In general, the penetration increased up to a disorientation of 86° with a broad minimum in the neighborhood of 50°. The results can be interpreted in terms of the density of atoms of misfit at the grain boundaries although little correlation seems to exist between penetration and grain-boundary energy at the cusp positions. (auth)

**6462**

Materials Lab., Wright Air Development Center

ELEVATED TEMPERATURE FATIGUE PROPERTIES OF SAE 4340 STEEL. W. J. Trapp. Dec. 1952. 56p. (WADC-TR-52-325(pt.1); AD-8716)

Test procedures and results of a fatigue investigation at room and elevated temperatures on SAE 4340 steel, oil quenched and tempered to 160,000 psi in the unnotched and notched condition, are presented. The notch used in the investigation is a 60° V notch with 0.010-in. radius and 0.025-in. depth. The results reveal the effect of temperature and stress ratio on the unnotched and notched fatigue properties. The fatigue tests were supplemented by stress-rupture and creep-rupture tests and by dynamic creep measurements. The investigation was conducted at room temperature, 600, 800, and 1000°F. The fatigue strength was found to decrease with increasing temperature at all stress levels and all stress ratios except for the life times between $10^5$ and $15 \times 10^6$ cycles in the notched condition, where at 600° the value is lower than at 800° and even lower than at 1000°, dependent upon stress ratio. This can probably be related to an increase in brittleness in the 600° region, which is also confirmed by the fact that the notch sensitivity at 600° was found to be higher than at any of the other temperatures investigated. The notch-sensitivity factor, based on maximum stress, is dependent upon temperature, stress level, and stress ratio. It generally decreases with increasing stress level, increasing temperature, and decreasing stress ratio. The peak of notch sensitivity is produced at completely reversed load for all temperatures. The tests indicated that creep is dependent upon mean stress rather than upon maximum stress. Two distinct types of creep-time diagrams were obtained, determined by stress ratio, mean stress, and temperature. A fracture study revealed certain relations between the type of creep diagram and type of fracture, inter and transgranular. (auth)

**6463**

New York State Coll. of Ceramics, Alfred Univ.

DIFFUSION OF IRON, NICKEL AND COBALT INTO HOT-PRESSED TITANIUM CARBIDE. Robert C. Turnbull. Jan. 1953. 30p. Contract AF 33 (038)-16190. (WADC-TR-53-1; AD-22309)

The diffusion of Fe, Ni, and Co into a hot-pressed TiC body was studied using the radioactive isotopes of these transition metals. The calculation of the diffusion coefficients was made both by the surface decrease method and by the determination of the concentration gradient within the sample. Measurements of the diffusion coefficient were made at 900, 1000, and 1100°C, but evidence is presented that D is dependent upon the structure of the sample. It appears that grain-boundary diffusion is the predominant type of diffusion occurring. Reproducibility of results, while working with polycrystalline material, is difficult because of the variables present in such a system. (auth)

**6464**

Armour Research Foundation

CONSTITUTION OF TITANIUM ALLOY SYSTEMS. Max Hansen, Donald J. McPherson, and William Rostoker. Feb. 1953. 261p. Contract AF33(038)-16347. (WADC-TR-53-41; AD-12612)

The information relating to the constitution of forty-eight binary and twenty-two ternary titanium alloy systems, including crystal structures, is compiled and evaluated. Introductory sections on the significance of phase diagrams in general and on possible types of binary titanium phase diagrams are included. Lattice parameter curves for terminal and intermediate solid solutions are presented. An effort was made to standardize the presentations from many sources, both published and unpublished, in every way possible for ease of comparison of all the systems. (auth)

**6465**

Rensselaer Polytechnic Inst.

MAGNESIUM ALLOY RESEARCH. A. Jones and R. R.

Nash. Oct. 1953. 185p. Contract W33-038-ac-22542. (WADC-TR-53-113; AD-24386)

A tentative constitutional diagram is presented for the magnesium-rich portion of the magnesium–thorium alloy system. This diagram shows limited solid solubility and a eutectic. The maximum solid solubility is estimated as 10% at the eutectic temperature of 1105°F. The eutectic composition contains about 35% thorium and the eutectic structure consists of an alpha solid solution and an intermediate phase containing about 55% thorium. Tentative diagrams are given to show the effect of zirconium on the phase boundaries for magnesium–zinc–zirconium alloys containing four and six percent zinc, respectively. Mechanical property data are given showing a good combination of strength and elongation in magnesium–1% zinc–0.4% cerium, magnesium–1% zinc–0.5% calcium, magnesium–1% zinc–0.4% cerium–0.001% lithium, and magnesium–1% zinc–0.4% cerium–0.005% calcium. Cerium refines the grain structure and introduces a second constituent. The best properties are associated with a fine equiaxed grain structure. Conditions and procedures are given for the controlled solidification method which produced magnesium and binary magnesium alloy single crystals with a nominal diameter of ½ in. and a length of about 8 in. Procedures are given for stressing the crystals in tension to establish the strengthening effects of the individual solutes. Work is reported up to the actual experimental stressing of the single crystals. (auth)

**6466**

Dow Chemical Co.
EXPERIMENTAL MAGNESIUM ALLOYS. PART 1. FURTHER DEVELOPMENT OF PELLET FABRICATED MAGNESIUM ALLOYS. Dow Chemical Co. and H. A. Johnson, ed., Materials Lab., Wright Air Development Center. June 1954. 62p. Contract AF(600)-19147. (WADC-TR-54-83(pt.1))

The effect of melt and Mg–Al pellet additions on the properties of Mg–Zn–Zr pellet and/or ingot fabrications was investigated in an attempt to develop higher strength sheet and extrusion alloys. The best combination of properties of Mg–Zn–Zr + Mg–Al pellet extrusions is obtained with ZK60; addition of Mg–Al decreases the sensitivity of the extrusion to annealing but does not improve the over-all properties of the base alloy. Certain melt additions result in significant improvements in the properties of Mg–Zn–Zr. In extrusions, QZ66 containing 2% MM offers much higher strength, particularly CYS, than ZK60, while in sheet ZK40 containing 1% MM and 1% Th has properties vastly superior to AZ31. (auth)

**6467**

Dow Chemical Co.
EXPERIMENTAL MAGNESIUM ALLOYS. PART 2. WROUGHT ALLOY SURVEY OF MINOR ADDITIONS TO SELECTED Mg-BASE ALLOYS. Dow Chemical Co. and H. A. Johnson, ed., Materials Lab., Wright Air Development Center. June 1954. 32p. Contract AF(600)-19147. (WADC-TR-54-83(pt.2))

The effect of 1% additions of Ba, Cb, Cr, Hg, Li, MM, Mo, Pd, Se, Ta, Te, Th, Ti, Tl, V, and W on the mechanical properties, workability, formability, corrosion resistance, and microstructure of Mg–3Zn and Mg–5Al was investigated. Th greatly improves the strength of Mg–3Zn in both extrusions and rolled strip without an appreciable loss of toughness. Smaller strength increases are obtained by the addition of Li, Ba, and Pd to both base alloys and with Hg and Cr in Mg–3Zn. Sizeable strength increases, through the addition of Th, Li, Pd, or Ba, are achieved only with an appreciable loss in workability, toughness, formability, and/or corrosion resistance. The other additions, Cb, MM, Mo, Se, Ta, Te, Ti, Tl, V, and W, have negligible effects. (auth)

**6468**

Dow Chemical Co.
EXPERIMENTAL MAGNESIUM ALLOYS. PART 3. THERMAL AND ELECTRICAL PROPERTIES OF MAGNESIUM BASE ALLOYS. Dow Chemical Co. and H. A. Johnson, ed., Materials Lab., Wright Air Development Center. June 1954. 37p. Contract AF(600)-19147. (WADC-TR-54-83(pt.3))

The effect of crystal orientation on the electrical resistivity of high-purity magnesium was determined. The results, at 24C, may be represented by the equation $\rho(\phi) = 4.60 - 0.75 \cos^2\phi$, where $\phi$ is the angle between the hexagonal axis and the direction of current flow. The effect of temperature on the electrical resistivity for varying orientations was investigated, with temperature coefficients of 0.00390 and 0.00408/C obtained perpendicular and parallel to the hexagonal axis, respectively, for the temperature range of 24 to 200°C. Extruded high-purity magnesium and ZK60A-T5 alloy were stressed in tension to various levels and the effect of this pre-stressing operation on the electrical resistivity recorded. There was no significant change in electrical resistivity at the levels investigated for either alloy. Apparatus for the measurement of thermal conductivity, electrical conductivity, and linear thermal expansion have been purchased or designed but are still in either the construction or calibration stage. The advantages and disadvantages of electric resistance strain gages as a method of measuring the coefficient of linear thermal expansion are discussed. (auth)

**6469**

Dow Chemical Co.
EXPERIMENTAL MAGNESIUM ALLOYS. PART 4. EVALUATION OF HK31. Dow Chemical Co. and H. A. Johnson, ed., Materials Lab., Wright Air Development Center. June 1954. 16p. Contract AF(600)-19147. (WADC-TR-54-83(pt.4))

Testing and evaluation of production-rolled HK31XA sheet (Mg–Th–Zr alloy) are reported. The results are preliminary insofar as the over-all production development of this alloy is concerned but do indicate the good combination of room and elevated temperature properties previously obtained in the laboratory can be produced under plant-scale rolling conditions. (auth)

**6470**

Dow Chemical Co.
EXPERIMENTAL MAGNESIUM ALLOYS. PART 5. WELDING TESTS ON HK31A SHEET. Dow Chemical Co. and H. A. Johnson, ed., Materials Lab., Wright Air Development Center. June 1954. 40p. Contract AF(600)-19147. (WADC-TR-54-83(pt.5))

HK31A alloy (Mg–Th–Zr alloy) was not crack sensitive and therefore was considered to be an extremely good weldable alloy. It could be readily arc and spot welded in sheet form. Some difficulty in obtaining sound arc welds in heavy plate was experienced. Gas welding using the current commercial fluxes was not satisfactory because of poor fluxing action. Spot welding could be performed on the equipment currently in use on magnesium. Settings and

properties closely approached those for AZ31A sheet. Cleaning for spot welding either by mechanical or chemical means was satisfactory. HK31 sheet welded satisfactorily to HK31A cast material but when welded to AZ63A, some cracking was experienced with HK31A rod. Cracking was eliminated with AZ92A rod. Welding to other sheet alloys appeared possible. Welding had no significant effect on corrosion rates. Post-weld solution heat treatments at temperatures below 1050°F were necessary to avoid germination of welds. Post-weld aging could be used to increase the strengths of welds made on sheet either in the –H24 or in the –T4 condition prior to welding. The short-time high temperature strengths were not significantly affected by welding. (auth)

**6471**

Fansteel Metallurgical Corp.

DEVELOPMENT OF A PROTECTIVE COATING FOR TITANIUM ALLOYS. FINAL REPORT [FOR] JUNE 1, 1953 THROUGH MAY 31, 1954. Stanley Kluz and Ralph Wehrmann. Aug. 25, 1954. 40p. Contract DA-11-022-ORD-1069. (WAL-401/15-35)

The investigation of silicon as a coating material for titanium was continued. Paint and sinter, vapor phase, and flame spray methods were studied. Coatings prepared by the first method increased the life span of titanium in air at 800°C by as much as a hundredfold. Cursory investigations of the last two methods indicated potential usefulness, particularly for some specific applications. Further study of silicon coatings should prove profitable. Titanium silicide powders were consolidated into pellets and bars by pressing at room temperature and sintering in vacuum. The silicides, $Ti_5Si_3$ and $TiSi_2$, are hard but reasonably strong intermetallic compounds which have very good oxidation resistance and relatively low electrical resistance. Crucibles of $Ti_5Si_3$ composition proved unsuitable as containers for melting titanium due to contamination with silicon which rendered the metal hard and brittle. (auth)

**6472**

Metals Research Lab., Case Inst. of Tech.

INVESTIGATION OF THE MECHANICAL PROPERTIES OF TITANIUM BASE ALLOYS. F. R. Brotzen, E. L. Harmon, and A. R. Troiano. Aug. 31, 1954. 46p. Contract DA33-019-ORD-941, Technical Report No. 3. (WAL-401/93-34)

Precipitation processes leading to drastic property changes are a frequent occurrence in titanium alloys containing large amounts of the retained high-temperature beta phase. In order to establish the kinetics and nature of these precipitation processes, a series of titanium–vanadium alloys was studied. Time-temperature-transformation diagrams were obtained for 12.5% and 15% vanadium–titanium alloys. These diagrams consisted of two intersecting C-shaped curves: one in the high-temperature region for the equilibrium transformation $\beta \rightarrow \alpha + \beta$, and another at lower temperatures depicting the formation of the metastable transition phase; omega. Presence of the transition phase retarded the precipitation of the equilibrium alpha phase. Deformation of retained beta resulted in the formation of the omega phase. Reversion and retrogression phenomena of the transition phase were observed. A negative temperature coefficient of resistance was found in quenched alloys containing from 15 to 20% vanadium. (cf. WAL-401/93-33.) (auth)

**6473**

Engineering Research Inst., Univ. of Mich.

HIGH-RESOLUTION AUTORADIOGRAPHY IN METALLURGY. INTERIM REPORT. H. J. Gomberg, G. C. Towe, M. J. Sinnott, S. Yukawa, C. Upthegrove, and R. A. Flinn. Feb. 1953. 44p. Contract DA-20-018-ORD-12150. (WAL-843/13-10; AD-5112)

Equipment and techniques used for the autoradiographic study of metallurgical problems are presented. Some results are given showing that high-resolution autoradiographic methods can be a very valuable tool in the study of such problems as the distribution of bismuth in cast and recrystallized copper, grain-boundary diffusion of liquid bismuth in copper, and absorption of hydrogen by copper-base alloys. Sources of artifacts in stripping film autoradiography are also discussed. (auth)

**6474**

STUDY OF THIN FILMS OF INTERMETALLIC COMPOUNDS. A. K. Kikdin and G. D. Fedorov. Translated from Doklady Akad. Nauk S.S.S.R. 92, 1163-5(1953). 6p. (AEC-tr-1948)

Thin films of Mg–Bi (1000A) were prepared by depositing the components of the system on a glass base by simultaneous evaporation in a vacuum. A narrow transparent band appeared on the thin film at the point where the composition corresponds to $Mg_3Bi_2$. The width of the transparent band increases with time, probably because of oxidation of the film in air. Films of Mg–As, Ca–Bi, and Ca–As also had a transparent band. (J.S.R.)

**6475**

THE SYSTEM OF ATOMIC RADII OF METALS. G. B. Bokii [Bokiy]. Translated from Doklady Akad. Nauk S.S.S.R. 89, 459-62(1953). 3p. (AERE-Trans-11/3/5/417)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 7-3786.

**6476**

INVESTIGATION OF THE PHASE DIAGRAMS OF THE SYSTEM FORMED BY THE METALLIC COMPOUNDS $Ni_3Nb$-$Ni_3Ta$. I. I. Kornilov and E. N. Pylaeva. Doklady Akad. Nauk S.S.S.R. 97, 455-7(1954) July 21. (In Russian).

The binary system composed of the intermetallic compounds $Ni_3Nb$ and $Ni_3Ta$, was investigated by means of thermal analysis and microstructure. The specific electric resistance, melting point, hardness, and specific gravity were determined as a function of the composition of the system. (J.S.R.)

**6477**

DIFFUSION OF $Co^{60}$ IN SOME Ni-Al ALLOYS CONTAINING EXCESS VACANCIES. A. E. Berkowitz, F. E. Jaumot Jr., and F. C. Nix (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 95, 1185-9(1954) Sept. 1.

The aluminum-rich compositions in the $\delta$ phase of Ni–Al exhibit vacancy densities considerably greater than the normal equilibrium concentrations. Measurements were made of the diffusion of $Co^{60}$ in six compositions in the $\delta$ phase of Ni–Al at 1050°C, 1150°C, 1250°C, and 1350°C. The diffusion coefficient had a minimum value at the stoichiometric composition. The activation energies had a maximum value at this composition and remained essentially constant at a lower value for the aluminum-rich alloys. An interpretation of this behavior in terms of a vacancy mechanism is discussed. (auth)

**6478**

FATIGUE NOTCH SENSITIVITY OF SOME ALUMINUM ALLOYS. J. A. Bennett and J. G. Weinberg (National Bureau of Standards, Washington, D. C.). J. Research Natl. Bur. Standards 52, 235-45(1954) May.

The notch sensitivity in fatigue was determined for 24S-T4, 61S-T6, and 75S-T6 aluminum alloys. Specimens having theoretical stress-concentration factors of 1.0, 1.4, and 1.8 were used, and the fatigue-strength reduction factor was based on the number of cycles required to initiate the fatigue crack. The values of notch sensitivity for 61S-T6 in the small radius specimens and for 24S-T4 were close to unity, whereas that for 75S-T6 was much lower. The data also provide information on the dispersion of fatigue results for the different alloys and the portion of the total life required for a fatigue crack to grow to fracture. (auth)

# PHYSICS

**6479**

Knolls Atomic Power Lab.

WHIP EFFECT IN A FALLING CHAIN. W. A. Heywood, H. Hurwitz, Jr., and D. Z. Ryan. [1954?] 5p. Contract W-31-109-Eng-52. (AECU-2926)

A simple experiment is described for demonstrating the whip effect in a falling chain. The observed reduction in fall time due to the concentration of energy in the falling section agrees well with the assumption of small energy loss in the loop of the chain. (auth)

**6480**

National Bureau of Standards

BIBLIOGRAPHY ON THE LESS ORDERED FORMS OF CARBON. Eleanor Tatge and H. F. McMurdie. Feb. 1954. 23p. Contract Na-ONR-123-52. (NBS-3141; AD-26693)

The bibliography contains 215 references concerning the less ordered forms of carbon. Listings are chronologically with respect to physical properties, chemistry, carbon black and other varieties, x-ray and electron beam studies, structure, and synthesis. (auth)

**6481**

NEW METHODS FOR THE MEASUREMENT OF THE SPECIFIC SURFACE (IN $cm^2/g$) AND OF THE SPECIFIC ADSORPTION (IN $g/cm^2$). 1. (Novye Metody Izmereniya Udel'noi Poverkhnosti (v $cm^2/g$) i Udel'noi adsorstsii (V $g/cm^2$). 1.) B. V. Deryagin, V. I. Krylova, and P. M. Fridlyand. Translated by Esther Rabkin from Zhur. Fiz. Khim. 24, 1371-82(1950). 29p. (TT-272)

A simple apparatus is described for measuring exactly the specific surface of porous bodies by means of the resistance to filtration of a rarefied gas. Specific surface measurements made by the new method compared favorably with measurements obtained by accepted methods. Data are included from measurements of the specific surface of a mixture of powders whose specific surface differs by as much as 50 times which indicate the new method applies also to this type of poly-dispersed mixture. (C.H.)

**6482**

MEASUREMENTS AT LOW TEMPERATURE AND HIGH PRESSURE. 1. DEVELOPMENT OF A METHOD OF PRODUCING HIGH PRESSURES AT LOW TEMPERATURES. (Izmereniya Pri Nizkikh Temperaturakh Pri Vysokikh Davlenihakh. 1. Razrabotka Metoda Sozdaniya Vysokikh Davlenii Pri Nizkikh Temperaturakh). B. Lazarev and L. Kan. Translated by G. Belkov from Zhur. Eksptl'. i Teoret. Fiz. 14, 439-47(1944). 20p. (TT-400)

A method for producing pressures from 2000 to $10^4$ $kgm/cm^2$ at temperatures of the order of liquid He has been developed. The pressures are generated by containment of substances ($H_2O$, Bi, Sb, and Ga) that are known to expand in passing from the liquid to solid state. (K.S.)

**6483**

THE DENSITY EFFECT FOR THE IONIZATION LOSS AT LOW ENERGIES. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 93, 351(1954) Jan. 15.

**6484**

ELECTRON SPIN RESONANCE IN BERYLLIUM. G. Feher and A. F. Kip (Univ. of California, Berkeley). Phys. Rev. 95, 1343-4(1954) Sept. 1.

The electron spin resonance in Be was observed at 300 and 9000 Mc/sec. The sample was in the form of particles embedded in paraffin, and were large in comparison to be skin depth. The ratio of maximum to minimum deflection of a typical absorption curve is dependent on the ratio of $T_D$, the time for electron diffusion through the skin depth, to $T_2$, the electron spin relaxation time. Theory predicts a ratio of 7.0, and an experimental value of $7.5 \pm 0.05$ was observed. The results are interpreted as proof that the observed resonance is due to conduction electrons rather than stationary paramagnetic impurities throughout the metal. A value of $T_2 = 2.0 \times 10^{-8}$ sec was found at 300 and 9000 Mc/sec, independent of temperature. The electronic g value at 9000 Mc/sec is $2.0032 \pm 0.0001$. (K.S.)

**6485**

ABSOLUTE CALIBRATION OF THE NBS STANDARD THERMAL NEUTRON DENSITY. James A. De Juren and Hyman Rosenwasser (National Bureau of Standards, Washington, D. C.). J. Research Natl. Bur. Standards 52, 93-6(1954) Feb.

A moderating geometry providing a constant thermal neutron flux from two radium–beryllium ($\alpha$,n) sources has been constructed. The flux at the center of the geometry has been calibrated by absolute alpha counting from boron films exposed in pulse ionization chambers. The boron capture cross section has been obtained by comparison of the NBS boron with the Argonne "standard" boron, and a value of $nv = 3918$ (±2 percent) $n/cm^2/sec$ has been determined for the flux. (auth)

**6486**

USE OF CALLENDAR'S "RADIO-BALANCE" FOR THE MEASUREMENT OF THE ENERGY EMISSION FROM RADIOACTIVE SOURCES. W. B. Mann (National Bureau of Standards, Washington, D. C.). J. Research Natl. Bur. Standards 52, 177-84(1954) Apr.

In 1910 H. L. Callendar described a calorimeter for measurement of radiant energy in which the quantity of heat to be measured is balanced against the cooling from a Peltier couple. He called this thermal-balance device a "radio-balance." The operation of the radio-balance has been extensively investigated to see whether it could be used for the accurate determination of the energy emission from radioactive sources. In the present experiments, measurements have been confined solely to radium preparations. For an absorption equivalent to 0.126 cm of lead a heat emission of 128.9 cal/g/hr has been found for radium in equilibrium with its products down to radium D. The estimated accuracy of this result is ± 0.7 percent. (auth)

## *AEROSOLS*

**6487**

AN ABSORBER FOR MISTS AND GASES IN AIR. A. A. W.

Russell (Government Lab., London, England). Analyst 79, 524-5(1954) Aug.

The absorber consists of a cylindrical glass vessel fitted with two sintered-glass disks (a lower one for drawing in the sample and an upper one as an impinger and for catching any spray formed by the bubbles from the lower one) and a stoppered filling tube inserted just below the upper disk and filled with 1-in. layer of absorbent above the lower disk. Results of tests on hydrofluoric acid and chromic acid sprays in air are reported. (J.A.G.)

## *COSMIC RADIATION*

**6488**

LOW-ENERGY EVENTS IN COSMIC RADIATION. L. Reiffel and G. M. Burgwald (Illinois Inst. of Tech., Chicago). Phys. Rev. 95, 1294(1954) Sept. 1.

The intensity of low-energy events in the cosmic radiation has been examined as a function of altitude with an energy-gated scintillation counter. Events selected were those giving pulses the equivalent of 0.2-Mev to 2.0-Mev electron energy loss in the scintillation crystal. Compared with data for total radiation, the present results show a shift toward lower altitudes by an almost constant fraction of a radiation length. (auth)

**6489**

ATMOSPHERIC TEMPERATURE EFFECT UPON THE COSMIC-RAY INTENSITY AT SEA LEVEL. Kaichi Maeda and Masami Wada. J. Sci. Research Inst. (Tokyo) 48, 71-9 (1954) June.

In order to illustrate the influence of atmospheric temperatures upon the cosmic-ray intensity observed at sea level, the coefficients are calculated as a function of energy and altitude by using the energy spectrum of cosmic-ray mesons. It is shown that the atmospheric temperature effect is expressed by two terms i.e., (1) ordinary temperature effect due to the decay of $\mu$ mesons, (2) positive temperature effect due to the variation of $\mu$-meson production rates. The latter effect increases with energy and becomes predominant in the upper atmosphere, while the former decreases with energy. In addition, the coefficient of partial temperature effect is defined and explained. (auth)

**6490**

COSMIC-RAY RECORDS OF THE SCIENTIFIC RESEARCH INSTITUTE. Yukio Miyazaki. J. Sci. Research Inst. (Tokyo) 48, 80-102(1954) June.

The observation of the intensity of cosmic rays, which has been continuously performed at the Institute, is reviewed. The description of a cosmic-ray meter and the method for reduction of data are given. The results which were obtained during the period from 1952 to 1953 are compiled, together with the graphical representation of monthly average intensity, daily variation and 27-day recurrence tendency of cosmic rays. (auth)

**6491**

ON THE TOTAL INTENSITY AND DIFFERENTIAL SPECTRA OF THE MOMENTA OF THE NUCLEAR COMPONENT OF COSMIC RADIATION NEAR THE EQUATOR OBSERVED IN A SENSITIVE EMULSION. Tsai-Chu and Max Morand. Compt. rend. 239, 415-18(1954) Aug. 2. (In French).

The momentum spectrum of slow protons, considering the angular distribution, shows a secondary maximum in the region of weak energies. For protons, the latitude effect is nearly two times smaller than for neutrons. (tr-auth)

## *CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE*

**6492**

RECRYSTALLIZATION OF AUSTENITE CAUSED BY INTERNAL STRESSES. K. A. Malyshev, V. D. Sadovskii, and B. G. Sazonov. Translated by R. D. Misch from Doklady Akad. Nauk S.S.S.R. 76, 61-4(1951). 9p. (AEC-tr-1949)

**6493**

THERMOELECTRIC POWER AND ELECTRON SCATTERING IN METAL ALLOYS. C. A. Domenicali and F. A. Otter (Franklin Inst. Labs., Philadelphia, Penna.). Phys. Rev. 95, 1134-42(1954) Sept. 1.

The thermoelectric power of a metal depends on the details of how the current carriers in the metal are scattered by the various deviations of the crystal from a perfect lattice. A semiempirical theory of thermoelectric power in metal alloys is described, which is based on a formula due to Mott and others. The theory relates absolute thermopower to the energy dependence of the scattering cross section $Q_i(\epsilon)$ of a lattice imperfection, and deduces numerical values for the first few "scattering coefficients" in a Taylor expansion of $Q_i(\epsilon)$ about the Fermi level $\mu_s$ in the pure solvent metal. The few known empirical "rules" of thermoelectric power in binary alloys of Cu, Ag, and Au, of alkali metals, and of Al are interpreted in terms of these scattering coefficients. The correlation with high-temperature thermoelectric properties of such alloys is shown to be quite satisfactory, but the low-temperature properties present several difficulties which cannot be properly discussed without further extensive experiments at very low temperatures. The usefulness of thermoelectricity as a tool for studying the nature of lattice imperfections is discussed briefly. (auth)

## *ELECTRICAL DISCHARGE*

**6494**

LOW-FREQUENCY OSCILLATIONS IN THE POSITIVE COLUMN OF THE GLOW DISCHARGE. M. E. Gertsenshtein and V. V. Potemkin. Zhur. Eksptl'. i Teoret. Fiz. 24, No. 6, 643-51(1953). (In Russian).

It has been shown that longitudinal electric waves in the positive column of a discharge are always accompanied by pulsations in the current intensity. By assuming simultaneity of waves and pulsations it becomes possible to explain the spatial periodicity of discharge luminescence and the phenomenon of moving luminescent layers. The simultaneity is confirmed by the analysis of oscillograms of the probe voltage. The theory proposed stipulates, in agreement with experimental data, that the periodic luminescent structure must disappear at low gas pressures. An amplifier with feedback is an equivalent model of the discharge in relation to oscillations. The analysis of this model yields the existence of several generating regions as well as the dependence of frequency on the anode-cathode distance; this agrees quantitatively with experiment. Another theoretical result is that the wave energy flux is always directed from cathode to anode, irrespective of the phase velocity. (Science Abstracts)

## *ELECTRONS*

**6495**

ON THE SCATTERING OF FAST ELECTRONS. III. RADIATION CORRECTION. H. Mitter and P. Urban (Univ. of Graz, Austria). Acta Phys. Austriaca 8, 356-69(1954) July. (In German).

The radiative corrections for the elastic scattering of electrons or positrons in a nuclear field were investigated with the aid of the Feynman-Dyson formalisms in the second Born approximation. Because of the length of the resulting expression, the extreme- and nonrelativistic case was investigated more closely, and a corresponding formula for the differential total cross section was given. (tr-auth)

**6496**

EFFECT OF CHEMICAL COMBINATION ON THE CHARACTERISTIC ENERGY LOSS OF ELECTRONS. Lewis B. Leder and L. Marton (National Bureau of Standards, Washington, D. C.). Phys. Rev. 95, 1345-6(1954) Sept. 1.

Characteristic energy losses of 30-kev electrons were studied by observing the spectrum shifts between Si, Te, Sb, Mg, and their oxides and sulfides. In all cases it was found that the general characteristic shape of the spectrum and its compound was similar, with a shift toward higher energy for the compounds. A preliminary explanation of the effect is proposed in manner analagous to the shift in K and L x-ray emission. The theory of Das Gupta has shown some correlation of K-valence emission band shift with the heat of formation, and it is shown that the application of this theory to the present problem yields values which are the correct order of magnitude. (K.S.)

## *GASES*

**6497**

APPARATUS FOR THE DETERMINATION OF MINOR COMPONENTS OF A GAS MIXTURE. Martin Shepherd (National Bureau of Standards, Washington, D. C.). J. Research Natl. Bur. Standards 52, 1-6(1954) Jan.

The apparatus is primarily for the determination of the components occurring in low partial pressures in a gas mixture and which ordinarily cannot be determined with satisfactory accuracy because of the significant sorption and desorption of major components in the reagents intended for the removal of the minor ones. Small amounts of solid and liquid reagents are used in the apparatus, and combustions, as well as absorptions, can be performed. The apparatus can be made a separate unit or part of a standard apparatus for volumetric chemical gas analysis. (auth)

## *INSTRUMENTS*

**6498**

X-Ray and Crystal Analysis Lab., Penna. State Univ.
NEW GONIOMETERS FOR SINGLE-CRYSTAL NEUTRON DIFFRACTION STUDIES. Ray Pepinsky, B. C. Fraser, and M. C. McKeown. X-Ray and Crystal Analysis Lab., Penna. State Univ. and Brookhaven National Lab. Mar. 20, 1954. 20p. Contract AT(30-1)-1516. (BNL-1918)

A new type of goniometer was designed and constructed for neutron diffraction analyses and particularly for single-crystal studies. The neutron-detecting system employs a scintillation crystal and photomultiplier, or a miniature high-pressure $BF_3$ counter. The detector and diffracting crystal are located within a cylindrical shielded region, in such a manner that the moving parts are entirely free of heavy shielding elements. When a miniaturized $BF_3$ counter is used, no shielding except $B_4C$ in plastic immediately surrounding the counter is required. Rotations are accomplished by servo-controlled motors, with selsyn indicators coupled to an external servo system. This servo control is designed to permit future introduction of automatic crystal and detector setting. The system is small and inexpensive and has the particular advantage of readily permitting three-dimensional diffraction measurements. (auth)

**6499**

Office of Basic Instrumentation, National Bureau of Standards
FACTORS AFFECTING THE PRECISION AND ACCURACY OF AN ABSOLUTE NOISE THERMOMETER. E. Walters Hogue. July 1954. 64p. (NBS-3471)

An evaluation of the factors affecting the precision and accuracy of an absolute thermometer whose principle of operation depends upon the comparison of thermally generated electrical noise in conductors is reported. (J.E.D.)

**6500**

Electron Tube Research Lab., Inst. of Tech., Univ. of Minn.
STUDY OF THE CAUSE AND EFFECT OF FLICKER NOISE IN VACUUM TUBES. SECOND QUARTERLY REPORT [FOR] DECEMBER 15, 1953 TO MARCH 15, 1954. A. van der Ziel. 40p. Contract DA-36-039-sc-56683. (NP-5323)

(For preceding period see NP-5149.)

**6501**

STATISTICAL THEORY OF THE MAGNETRON (STATIC-REGIME). G. Ya. Lyubarskii and L. E. Pargamanik. Translated from Doklady Akad. Nauk S.S.S.R. 84, 491-4 (1952). 5p. (AERE-Trans-11/3/5/397)

## *ISOTOPES*

**6502**

Carbide and Carbon Chemicals Co. (K-25)
NATURAL ABUNDANCE OF THE BROMINE ISOTOPES. A. E. Cameron and E. L. Lippert, Jr. Sept. 17, 1954. 6p. Contract W-7405-eng-26. (K-1166)

Five samples of bromine from known geological origins have been converted to sodium bromide and the ratio of $NaBr^{79}/NaBr^{81}$ determined with two mass spectrometers over a period of a year. No significant differences appear between the samples, indicating a constancy of ratio with these origins at least. The over-all average for the 79/81 ratio was observed to be $1.0217 \pm 0.0002$. This is in excellent agreement with $1.0210 \pm 0.002$, which is the accepted value. (auth)

**6503**

Carbide and Carbon Chemicals Co. (K-25)
THE NATURAL ABUNDANCE OF THE LITHIUM ISOTOPES. A. E. Cameron. Sept. 15, 1954. 15p. Contract W-7405-eng-26. (K-1168)

Lithium samples from commercial and from known mineralogical sources have been investigated, and the variation in the $Li^7/Li^6$ ratio with origin is established. Measurements have been made on the $Li^6Li^7I^+$ and $Li^7Li^7I^+$ ions at masses 141 and 140. Sublimation of the iodide is free from discriminatory effects, and no corrections need be applied. This ratio has been shown to be unaffected by variations in instrumental conditions and is believed to be reliable. The variation of $Li^7/Li^6$ ratio in commercial chemicals has been observed to be between 12.44 and 12.93. Minerals examined show variations in the $^7/_6$ ratio between 12.47 and 12.72. Partial precipitation of lithium as phosphate or carbonate is shown to effect an isotope separation. (auth)

**6504**

A 10.5-DAY ISOTOPE OF PLATINUM. R. A. Naumann (Princeton Univ., N. J.). Phys. Rev. 94, 794(1954) May 1.

Metallic iridium has been irradiated with 50-Mev protons in the Columbia and Harvard University synchrocyclotrons and a platinum fraction has been chemically isolated from the bombarded targets. The decay of the platinum fractions has been observed employing end-window Geiger counters and shows a 10.5-day period which has been followed for 60 days. An iridium fraction showing a 40-hour decay component has been isolated from the 10.5-day platinum while the latter fraction, after repurification, shows an increase in activity compatible with the growth of a 40-hour daughter. A mass assignment of 188 to the platinum activity is supported by a previous assignment of a 41-hour iridium activity as iridium 188. Several conversion electron lines have been found to be associated with the decay of the platinum activity. Further studies on the decay schemes of these activities are continuing. (auth)

**6505**

INVENTORY OF ELECTROMAGNETICALLY-ENRICHED ISOTOPES. [1954]. 121p. (Oak Ridge National Lab., Tenn.)

This catalog of stable enriched isotopes constitutes an inventory listing of available isotopes from the Oak Ridge National Laboratory. The isotopic abundance, product form, and quantity available are listed for each mass number. A number of particular radioactive isotopes, as well as non-isotopic elements, are specifically excluded. Supplementary sheets are periodically issued to keep the inventory current. Copies are available from Dr. C. P. Keim, Director, Stable Isotope Research and Production Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. (K.S.)

## *ISOTOPE SEPARATION*

**6506**

Oak Ridge National Lab.

A 2800°C CALUTRON ION SOURCE UNIT AND ITS USE IN SEPARATING THE ISOTOPES OF Pd, Pt, Ru, AND Ir. W. A. Bell, Jr., L. O. Love, and C. E. Norman. July 30, 1954. 26p. Contract W-7405-eng-26. (ORNL-1767)

A calutron source capable of heating small (10g) quantities of charge material to approximately 2800°C was developed. Design features are discussed, and separations of isotopic samples (Pd, Pt, Ru, Ir) made possible by use of this source are summarized. (auth)

## *MASS SPECTROGRAPHY*

**6507**

Oak Ridge National Lab.

FILAMENT LIFE IN LOW PRESSURE ARC TYPE ION SOURCE. O. C. Yonts. Sept. 13, 1954. 43p. Contract W-7405-eng-26. (ORNL-1758)

Results of studies of filament erosion occurring in the separation of stable isotopes is presented. Erosion is shown to be dependent on arc power, and a method of reducing arc power without seriously decreasing ion output is also presented. (auth)

## *MATHEMATICS*

**6508**

Oak Ridge National Lab.

ON NORMS OF VECTORS AND MATRICES. A. S. Householder. Sept. 14, 1954. 21p. Contract W-7405-eng-26. (ORNL-1756)

**6509**

TABLE OF THE POTENTIAL OF A MAGNETIC PLATE OF CIRCULAR EDGE. Bice Pelini. Translated from Atti accad. naz'l. Lincei Rend. Classe sci. fiz. mat. è nat. [6] 12, 216-22(1930). 11p. (AEC-tr-1950)

**6510**

HOW TO USE SHORT-CUT STATISTICS. F. Proschan and A. R. Babcock, Jr. Chem. Eng. 61, No. 9, 193-7(1954) Sept.

Suggested applications, reliability, techniques, methods, and uses of short-cut statistics in analysis are discussed. (J.A.G.)

## *MEASURING INSTRUMENTS AND TECHNIQUES*

**6511**

Ames Lab.

A PROPORTIONAL COUNTER FOR LOW ENERGY BETA-RAY SPECTROMETRY. J. P. Mize and D. J. Zaffarano. [Aug. 24, 1954]. 18p. Contract [W-7405-eng-82]. (ISC-513)

The design and performance of a proportional counter spectrometer for the study of soft beta rays are described. Beta-ray sources are deposited on thin plastic films and are mounted inside the counting chamber in a detection geometry of essentially 4π steradians. The pressure of the filling admixture is adjusted so that none of the beta particles strikes the walls of the counter. Beta spectra are readily obtained with sources having total activities less than ten millimicrocuries. Deviations from the allowed shape for the low-energy portion of the $S^{35}$ spectrum reported by other workers who have used radioactive gas sources in proportional counters were not observed with the present instrument. The counter is useful for the spectroscopy of low-energy x rays and gamma rays as well as for measuring the absolute intensities of radioactive sources which decay by beta emission. (auth)

**6512**

Naval Research Lab.

A STANDARD SOURCE OF RADIATION FOR RADIAC DETECTORS. H. M. Childers, A. E. Nash, and J. D. Graves. Aug. 19, 1954. 17p. (NRL-4394)

Two radiation field ranges of similar design have been constructed and calibrated at the Naval Research Laboratory for use with $Co^{60}$ and $Cs^{137}$ sources to produce standard gamma fields. $Co^{60}$ sources have been employed in both the high- and low-intensity range to give calibrated field values continuously variable between 0.002 and 100.0 r/hr to within 3 percent, and reproducible to within 0.3 percent. The low-intensity range has been calibrated using $Cs^{137}$ to give field values from 0.001 to 0.45 r/hr to within 5 percent, and reproducible to within 0.3 percent. Included in the report are results of a study of the uniformity of the field intensities and the effect of shielding in the vicinity of the field points. (auth)

**6513**

Naval Research Lab.

FUEL ELEMENT DOSIMETRY BY ABSORPTION CHANGES IN SILVER ACTIVATED PHOSPHATE GLASS. Herbert Rabin. June 7. 1954. 20p. (NRL-Memo-309)

A series of experiments were performed to determine the effectiveness of using the optical density changes of silver-activated phosphate glass in monitoring the time-dependent, high-rate gamma fields of spent uranium fuel

elements. The results indicate that the response of the glass to fuel element irradiation is independent of both fuel element age and irradiation rate over the range of the experimental data obtained and that by performing an initial calibration in the fuel element field, this glass may be advantageously used in fuel element dosimetry. (auth)

**6514**

K-9. A LARGE 4π GAMMA-RAY DETECTOR. M. A. Van Dilla (Univ. of Utah, Salt Lake City) and R. L. Schuch and E. C. Anderson (Los Alamos Scientific Lab., N. Mex.). Nucleonics 12, No. 9, 22-7(1954) Sept.

An annular scintillation counter is described which will accommodate a 9-kg dog for whole-body measurements. The arrangement of eight photomultiplier tubes assures the counter being relatively insensitive to source position. Results from measurements made on rats injected with radium and on dogs injected with radium and radiothorium indicate a lower detection limit of 0.002 μg radium in a dog. (C.H.)

**6515**

GAMMA-RAY DOSIMETRY WITH CELLOPHANE–DYE SYSTEMS. Ernest J. Henley (Columbia Univ., New York). Nucleonics 12, No. 9, 62-3(1954) Sept.

Moistureproof, heat-sealable cellophane containing a dimethoxy-diphenyl-diazo-bis-8-amino-1-naphthol-5-7-disulphonic acid dye is suggested as an economical material whose optical and physical characteristics insure its satisfactory use as a chemical radiation detector for γ radiation. (C.H.)

**6516**

CONCERNING THE FACTOR OF CONTRACTION OF A NUCLEAR EMULSION. J. Fernández Ferrer and M. Pujal Carrera (Univ. of Barcelona, Spain). Anales real soc. espan. fis. y quim. (Madrid) Ser. A 50, 151-4(1954) July-Aug. (In Spanish).

In measuring the traces of a monokinetic collection of alpha particles, Horan found an increase of the apparent length when their inclination rises, showing the possibility of a nonuniform contraction. Following Vigneron's method a contraction factor of a NTA plate to different depths was determined, finding that it follows a regular variation which yields approximately to a parabolic law. (auth)

## *MESONS*

**6517**

Brookhaven National Lab.

COSMOTRON RESULTS ON PION-NUCLEON INTERACTIONS. Alan M. Thorndike. [1954] 15p. (BNL-1957)

Attenuation measurements with counter telescopes have determined the total π-p cross section at energies from 0.2 to 1.5 bev. For $\pi^+$, $\sigma_t$ drops to about 27 mb at 0.45 bev and is roughly constant at higher energies. For $\pi^-$, $\sigma_t$ drops to about 25 mb, then rises to 49 mb at 1.0 bev and drops to 34 mb at 1.5 bev. Cloud chamber and emulsion observations show that at the lower energies elastic scatterings predominate, but at 1.5 bev many interactions lead to the production of secondary pions. Cases have been observed in which there are two secondary pions. In the production of pions by nucleon-nucleon collisions at about 2 bev, two pions are frequently emitted. The observations seem inconsistent with the Fermi statistical theory. Energy and angular distributions suggest that a strongly interacting state, such as that inferred from π-p scattering with isotopic spin and angular momentum of $\frac{3}{2}$, may have a large influence on pion production. (auth)

**6518**

Brookhaven National Lab.

COSMOTRON PRODUCTION OF HEAVY MESONS. A[lan] M. Thorndike. 1954. 13p. (BNL-1958)

A general discussion of heavy meson events observed in cloud-chamber studies with the Cosmotron is given. (K.S.)

**6519**

Radiation Lab., Univ. of Calif., Berkeley

THE MESON MASS RATIO AND ENERGY BALANCE IN PI-MU DECAY (thesis). Wallace Birnbaum. Mar. 1954. 135p. Contract W-7405-eng-48. (UCRL-2522)

The mass-normalization method of measuring meson masses is extended to a determination of the positive pion-muon mass ratio. Ranges and momenta of the comparison particles produced in the 184-in. cyclotron are measured, employing the nuclear emulsion technique. The different energy-loss processes in nuclear emulsion are considered, and various range-straggling effects are evaluated and studied experimentally. The energetics of the $\pi \rightarrow \mu + \nu$ decay scheme are also studied in detail. From precise determinations of the absolute decay momentum $P_0$ of the muon and the $\pi/\mu$ mass ratio, various meson mass and related experimental values are obtained: $m_\pi^+/m_\mu^+ = 1.321 \pm 0.002$; $p_0 = 29.80 \pm 0.07$ Mev/c; a new probable upper limit to the mass, $m_\nu$, of the neutral decay particle of $\approx 6$ to 7 $m_0$; and a muon center-of-mass kinetic energy of $4.12 \pm 0.02$ Mev. With the positive-pion mass value found by Smith, the $m_\pi^+/m_\mu^+$ ratio yields $m_\mu^+ = 206.9 \pm 0.4\ m_0$. The following values in parenthesis are insensitive to $m_\nu$ and have been determined assuming $m_\nu = 0$: $m_\pi^+ - m_\mu^+ = (66.41 \pm 0.07\ m_0)$; $m_\mu^+ = (206.9 \pm 0.2\ m_0)$ from the Smith pion value and the mass difference reported here; $m_\pi^+ = (273.5 \pm 1.2 m_0)$ and $m_\mu^+ = (207.1 \pm 1.1\ m_0)$ derived solely from the pion-muon mass ratio and mass difference. A summary of many of the important pion and muon mass determinations by other researchers is compiled and presented for comparison. (auth)

**6520**

ON THE THEORY OF π MESONS. Ya. B. Zel'dovich. Doklady Akad. Nauk S.S.S.R. 97, 225-8(1954) July 11. (In Russian).

The theoretical representation of mesons or nuclei is applied to the question of the difference in mass of $\pi^\pm$ and $\pi^0$. The difference in mass of $\pi^\pm$ and $\pi^0$ is treated as the difference in energy of mirror nuclei, depending on Coulomb interaction. (J.S.R.)

**6521**

ON THE DECAY OF CHARGED π MESONS. Ya B. Zel'-dovich. Doklady Akad. Nauk S.S.S.R. 97, 421-4(1954) July 21. (In Russian).

**6522**

ON THE SPECTRA OF π MESONS AT ALTITUDES OF 3200 METERS. A. Alikhanyan. Doklady Akad. Nauk S.S.S.R. 97, 425-8(1954) July 21. (In Russian).

The spectrum of $\pi^-$ mesons from cosmic-ray collisions was measured at an altitude of 3200 m with a mass spectrometer connected with a hodoscope. The method of measurement and the results are discussed in detail. (J.S.R.)

**6523**

SEA-LEVEL MESONS STOPPED IN THIN Pb AND Al FOILS. I. POSSIBLE EMISSION OF CHARGED NUCLEAR PARTI-

CLES AND RELATED EVENTS. W. Y. Chang (Purdue Univ., Lafayette, Ind.). Phys. Rev. 95, 1282-7(1954) Sept. 1.

Further cloud-chamber experiments are described on the stopping of sea-level mesons in thin foils of Pb (5 of 0.009 and 6 of 0.018 inch) and Al (8 of 0.004 and 3 of 0.032 inch). Eighty-one negative $\mu$ mesons are seen to stop in the Pb foils (50 in the thick foils and 31 in the thin ones). Only two cases show some evidence of slow proton or alpha emission, as indicated by a heavy dot at the end of the stopped negative meson. In the case of Al, there are 36 negative mesons stopped, 12 and 24 in the thin and thick foils, respectively. None of these cases gives any observable evidence of a nuclear event at the place where the negative meson stops. From these statistics, upper limits have been estimated for the probability of nuclear ejection of protons and alpha particles of different energies. It is thus found that, to be ejected from a Pb nucleus with reasonable probability, a proton must have an energy between 3 and 12 Mev, in agreement with the emulsion results of other workers. For Al, since no nuclear event has been observed, it is concluded that the maximum probability of nuclear ejection must be less than 10 percent for a proton of an energy in the above range. An alpha particle in this energy range is improbably emitted from either an Al or a Pb nucleus. As in the previous experiments, no long-track and narrow-angle electron pairs have been observed in either Pb or Al which can be attributed to high-energy photons over 15 Mev emitted from the stopped negative $\mu$ meson (or decaying meson). Thus we find no high-energy gamma rays and evidence for the rarity of even low-energy nuclear events. Consequently we draw the same conclusions as in earlier less extensive experiments: that following the nuclear interaction only a small part of the $\mu$ meson's rest energy is imparted to the nucleus, and that the remaining part must go off as neutral, non-electromagnetic radiation, to escape observation in the cloud chamber. Altogether, 87 decaying mesons having been actually found from the two (previous and present) series of experiments. None of the decay electrons has been seen to move toward any one of the anticoincidence counters below the chamber. From this fact, the solid angle covered by the anticoincidence counters, and the absorbing material above the counters, one argues that the proportion of $\mu$-decay electrons with energy smaller than 10 Mev is of the order of 1 in 60 or less. (auth)

**6524**

SEA-LEVEL MESONS STOPPED IN THIN Pb AND Al FOILS. II. LOW-ENERGY (1-5 MEV) GAMMA RAYS. W. Y. Chang (Purdue Univ., Lafayette, Ind.). Phys. Rev. 95, 1288-93(1954) Sept. 1.

Low-energy gamma rays (1-5 Mev) associated with the stopped negative $\mu$ mesons, similar to those reported before, having been observed also in these experiments. Twenty-five meson-oriented electrons and pairs have been found in Pb associated with 23 of the 81 stopped negative $\mu$ mesons. They are "meson-oriented" in the sense that the single electron track (or apex of the pair) makes an angle less than $\pm$ 20° with the imaginary line running back to the end point where the meson is stopped. None of such events has been obtained from Al. Of the 25 directed events, 4 are single electrons emitted directly from the end point of the stopped negative $\mu$ mesons, one being fairly energetic and the other three rather slow. The other 21 are single electrons and pairs observed in each case at a foil different from that where the meson stops and are meson-oriented in the above sense. The reality of this angular correlation follows from the fact that the 81 photographs of negative mesons stopped in Pb show only 6 electron tracks which make an angle of 90° $\pm$ 20° with the line back to the end point of the meson track (6/21 as many tracks for 6 times as much solid angle). An independent determination of the rate of the strays was made by examining a film of 575 pictures to see how many tracks point by chance toward or away from an arbitrary point in the chamber with a 20° tolerance. From both ways of counting accidentals it is concluded that, of the 21 meson oriented events, at most about $\frac{1}{5}$ can be explained as stray tracks. A crude analysis of the electron range in the Pb foils indicates that the majority of the "oriented electrons" and "oriented pairs" may be interpreted as having an energy of about 5 Mev and the rest an energy probably below 3 Mev. The multiplicity of the photons producing these electrons has also been estimated, after a correction has been made for the multiple scattering of the electrons in the first foil, where they are emitted, so as to include all the electrons other than those counted within the cone (±20°) in the forward direction of the photons. The value for the multiplicity obtained is about 4.5 per negative meson stopped. The energy and frequency of occurrence of these photons are thus consistent with that predicted in Wheeler's theory of meson transition between the Bohr orbits and with that expected from nuclear de-excitation following the $\mu$-meson capture. (auth)

**6525**

TOTAL CROSS SECTION FOR CHARGE EXCHANGE SCATTERING OF $\pi^-$ MESONS BY HYDROGEN AT 42, 30, AND 20 MEV. W. J. Spry (Univ. of Rochester, N. Y.). Phys. Rev. 95, 1295-1300(1954) Sept. 1.

A measurement of the total cross section for the reaction $p(\pi^-,\pi^0)n$ has been made at three energies using polyethylene and carbon targets in a difference experiment. The values obtained for the cross sections are $\sigma$(42 Mev) = 6.9 ± 1.2 mb; $\sigma$(30 Mev) = 5.7 ± 0.9 mb; and $\sigma$(20 Mev) = 5.0 ± 0.8 mb. The results are analyzed under the assumption of charge independence in an attempt to determine the energy dependence of the S-wave phase shifts. (auth)

**6526**

LIMITS ON $\pi^-$ MESON MASS FROM MESONIC X-RAYS. M. Stearns, M. B. Stearns, S. DeBenedetti, and L. Leipuner (Carnegie Inst. of Tech., Pittsburgh, Penna.). Phys. Rev. 95, 1353-4(1954) Sept. 1.

An upper and lower limit for the $\pi^-$ mass is obtained from experiments on the critical absorption of mesonic x rays. The transmission of mesonic x rays was measured by placing various absorbers between the x-ray target and a NaI detector. The absorbers were aqueous solutions of salt whose concentration was adjusted in such a way that x rays of energy immediately below the K absorption edge would be transmitted 4 times more intensely than x rays of energy immediately above the edge. From the data of a typical run, 272.2 $m_e \leq m_{\pi^-} \leq 273.6\ m_e$. (K.S.)

**6527**

RADIATIVE DECAY OF THE $\theta^0$ PARTICLE. S. B. Treiman (Princeton Univ., N. J.). Phys. Rev. 95, 1360-2(1954) Sept. 1

Recent evidence from the decay of new unstable particles indicates that "anomalous" decay modes may be expected, similar to the anomalous pion decay at rest. In particular, it is noted that the decay mode $\theta^0 \rightarrow \pi^+ + \pi^- + Q_0$, with $Q_0$ = 2.4 ± 5 Mev, appears to be anomalous with events predicted by radiative decay. It is pointed out, however, that since a very few anomalous results have been reported, it

may be possible to account for a $\theta^*$ radiative decay process by construction of a probability function. Such an analysis is developed, and gives a total probability for finding a Q value below 194 Mev of ~0.7%. (K.S.)

## *METEOROLOGY*

**6528**

Brookhaven National Lab.
THE ROTARY RAIN INDICATOR, AN ELECTRICAL PRECIPITATION TIME RECORDER. Gilbert S. Raynor. [1953] 14p. (BNL-1892)

The rotary rain indicator, an electrical device for recording the time of beginning and ending of periods of precipitation, was developed at the Brookhaven National Laboratory Meteorology Group and has operated successfully for eight months. Its sensitive element consists of a rotating grid whose circuit may be completed by a drop of water. (auth)

## *NEUTRONS*

**6529**

ON THE DISTRIBUTION OF THERMAL NEUTRONS FROM A FAST NEUTRON SOURCE PLACED AT THE INTERFACE OF TWO MEDIA. R. Ramanna and S. B. D. Iyengar (Tata Inst. of Fundamental Research, Bombay, India). Proc. Indian Acad. Sci. A40, 8-21(1954) July.

The effect of a paraffin reflector on the spatial distribution of thermal neutrons due to a point source of fast neutrons at the surface of a graphite moderator is investigated. The reflecting properties of paraffin were found to be inferior to that of pure graphite. (K.S.)

**6530**

APPLICATIONS OF THE THEORY OF THE SLOWING DOWN OF NEUTRONS. M. Demeur, A. Gribaumont, and P. Janssens (Univ. Libro Brussels, Belgium). Bull. classe Acad. sci. roy. Belg. 40, 526 38(1954) May. (In French).

The Langevin method is applied to two problems posed by radiochemistry and radiogeology. It is particularly useful when one or more impacts play an important role. The method, based on the transport equation, is applied to the problem of energy and time distributions. (tr-auth)

## *NUCLEAR PHYSICS*

**6531**

Argonne National Lab.
PHYSICS DIVISION QUARTERLY REPORT [FOR] DECEMBER 1953, JANUARY AND FEBRUARY 1954. Aug., 1954. 109p. Contract W-31-109-eng-38. (ANL-5273)

Experimental Nuclear Physics. Neutron transmission measurements have been completed on normal Zn and its four main isotopes within the energy region from 200 ev to 10 kev. Values of $\Gamma$ are tabulated. Several modifications of the ANL Van de Graaff machine are described, together with a scheme for aligning the 90° electrostatic analyzer. Excitation levels of even-even nuclei predicted by the collective model of nuclear structure were examined with experiments using several rare-earth isotopes. Radioactivity and decay scheme studies are reported for $Sb^{122}$, $Ge^{75}$, $Ge^{77}$, $Ge^{77*}$, and $Pt^{199}$. A technique has been developed for measuring the nuclear magnetic moment of an excited nucleus decaying with two successive $\gamma$ rays by determining the change produced in the angular correlation by an applied magnetic field. A theoretical analysis of neutron cross section data, starting with the single-level Breit-Wigner formula, is applied to experimental results with $F_2$, Ti, and Ni. Neutron resonances and resonance widths in $Li^6$ and $Li^7$ were also investigated. Theoretical Physics. Calculation of the level scheme for mass number A = 13 with intermediate coupling has been completed. The level order resulting from a solution of the secular equations exhibit level shifts from the values of the diagonal energy matrix elements. A formalism is developed for the "cloudy crystal ball" model for neutron scattering by heavy nuclei. It is shown that the effect of inelastic scattering in levels of $Na^{23}$ has appreciable effect on the total neutron cross section of $Na^{23}$, particularly in the assignment of spin and parities. Nonrelativistic internal conversion coefficients for magnetic radiations have been computed for the three L subshells in the Pauli approximation. The relative internal conversion coefficients were evaluated for multipole orders 1 through 5 with the aid of hypergeometric functions. (For preceding period see ANL-5174.) (K.S.)

**6532**

Purdue Research Foundation
RESEARCH IN NUCLEAR PHYSICS. PROGRESS REPORT NO. 4. June 15, 1954. 86p. Contract AT(11-1)-122. (COO-171)

The snout arrangement used for focusing the Purdue cyclotron beam is described in detail. The excitation of the 40-kev isomeric state of $Rh^{103}$ and the 340-kev isomeric state of $In^{115}$ was studied. An apparatus for measuring the directional angular correlation of $\gamma$-$\gamma$ transitions was constructed. The possibility of an M2 admixture to the electric dipole 1.490-Mev $\gamma$ transition in $Nd^{144}$ was investigated. The directional correlation of the $A^{38}$ $\gamma$ rays was measured. The directional correlation of the $\gamma$ cascades from $Te^{122}$ and $Hg^{198}$ was studied. The influence of extranuclear fields on the directional correlations studied was determined. The influence of randomly fluctuating interactions, such as exist in liquids, on the angular correlation of $Cd^{111}$ and $Ta^{181}$ $\gamma$ radiation was studied. The effects of extranuclear interactions in In and Ag on the directional correlation of $Cd^{111}$ $\gamma$ rays were studied. Polarization-directional correlation of $Nd^{144}$ and $Cd^{114}$ $\gamma$ rays was made. The decay scheme of $Sc^{44}$ was reinvestigated. Conversion coefficient measurements were made on $Cd^{110}$, $Pt^{196}$, and $Pt^{194}$ $\gamma$ rays. The canning and mounting of NaI(Tl) crystals for scintillation spectroscopy is described. (For preceding period see COO-170.) (J.S.R.)

**6533**

Ames Lab.
QUARTERLY SUMMARY RESEARCH REPORT IN PHYSICS FOR APRIL, MAY, AND JUNE 1954. Aug. 27, 1954. 13p. Contract W-7405-eng-82. (ISC-508)

A theoretical basis for explaining the specific heats of light rare earth metals was sought by considering the effects of electronic quadrupole interactions. The application of this theory has found some success in the structure of hexagonal Ce. A method was developed for the production of thin $Li_2C^*O_3$ sources of high uniformity. The photodisintegration of $C^{12}$, $N^{14}$, and $O^{16}$ by 70-Mev $\gamma$ rays was analyzed by using nuclear emulsions. The reaction $N^{14}(\gamma,np)3\alpha$ occurs at least 4 times as often as $N^{14}(\gamma,np)\alpha$. The half lives of $Li^8$, $He^6$, $O^{15}$, $Ca^{39}$, $Cl^{34}$, and $K^{38}$ were measured with an anthracene scintillation spectrometer. Data on the thermal conductivity of rare earth metals indicate that these metals are poor heat conductors. (For preceding period see ISC-487.) (K.S.)

**6534**

Radiation Lab., Univ. of Calif., Berkeley

PHYSICS DIVISION QUARTERLY REPORT [FOR] FEBRUARY, MARCH, APRIL 1954. June 21, 1954. 58p. Contract W-7405-eng-48. (UCRL-2630)

Experiments on the polarization of particles by nuclei have been performed in order to investigate the polarization mechanism, particularly the role of L·S interactions for elastic scattering at high energies. Proton polarization by Al shows some qualitative features predicted by L·S coupling, but difficulty was experienced in separating the truly elastic events. Other results with the polarization of 190-Mev deuterons by C suggest that the L·S interaction is small compared to the main nuclear potential. Studies of photomeson production in nuclear emulsions, using the spiral-orbit spectrometer, give $\pi^-/\pi^+ = 1.86$ and 1.1 for carbon and deuterium, respectively. The ratio of $\pi^+$ mesons produced in hydrogen and deuterium is 1.2. A study of the positron spectrum from the decay of $\mu$ mesons has been completed, and the results are presented. The spiral orbit spectrometer was also applied to an analysis of $\pi^+$ scattering by protons and carbon. Cross sections for the proton production of deuterons with nuclei of varying A have been determined. From this data, together with deuteron production information by neutrons, the neutron fraction of surface nucleons in C and Pb is found to be 0.47 ± 0.09 and 0.80 ± 0.13, respectively. A 15.2 ± 0.2-Mev $\gamma$ line has been observed as a result of proton bombardment of C. Relative values of the differential cross section from C at 90° (lab) have been determined for proton energies of 30, 60, 100, 140, 250, and 340 Mev. Tendencies toward spherical symmetry in the differential cross section of $p + p \rightarrow \pi^+ + d$ were investigated. Assuming that the cross section is of the form $a + \cos^2\theta$, values of a for proton energies of 326 and 313 Mev were 0.30 ± 0.04 and 0.35 ± 0.07. Data were obtained on the polarization of neutrons produced by the bombardment of C by 285 Mev, 65% polarized protons. Further design modifications and operation of the bevatron are described. (For preceding period see UCRL-2513.) (K.S.)

## *NUCLEAR PROPERTIES*

**6535**

ON THE SEMI-EMPIRICAL MASS-FORMULA AND ALPHA-DISINTEGRATION ENERGY IN THE REGION OF HEAVY AND MEDIUM HEAVY NUCLIDES. G. P. Dube, and Lal Saheb Singh (Patna Univ., India). Proc. Indian Acad. Sci. 40, 37-46(1954) July.

It is shown that Fermi's semi-empirical atomic mass formula is inadequate for the estimation of alpha-disintegration energy in the medium-heavy and heavy nuclide regions. A suitable correction term has been added to the mass formula based on Duckworth's new atomic masses and similar to the one proposed by Stern for heavy elements ($A \geq 208$). It is seen that the calculated alpha-decay energies are in numerical agreement with the observed data except for the magic number nuclei which can be satisfactorily explained on the nuclear shell structure. But even in the latter case the agreement with the experimental results is better when the correction term is used. (auth)

**6536**

HALF-LIFE OF THALLIUM-204. D. L. Horrocks and A. F. Voigt (Iowa State Coll., Ames). Phys. Rev. 95, 1205 (1954) Sept. 1

A determination of the half life of $Tl^{204}$, based on measurements over a 3-yr period, gives a value of 4.1 ± 0.1 yr. (auth)

**6537**

INTERNAL BREMSSTRAHLUNG. R. E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh, Penna.). Phys. Rev. 95, 1222-5 (1954) Sept. 1.

Some theorems are given which apply to the beta radiation and internal bremsstrahlung emitted by light nuclei. Use of these theorems simplifies the calculation of approximate spectra and angular correlations. The principal new result is a simple, explicit relation between the spectra and angular correlations of the internal bremsstrahlung of K capture and the spectra and angular correlations of positrons. (auth)

**6538**

NATURAL RADIOACTIVITY OF $Sm^{147}$. George Beard and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). Phys. Rev. 95, 1245-6(1954) Sept. 1.

The half life of $Sm^{147}$ has been measured to be $1.25 \pm 0.06 \times 10^{11}$ years with an energy distribution corresponding to the emission of monoenergetic alpha particles. (auth)

**6539**

NUCLEAR DEFORMATION AND THE MOMENT OF INERTIA OF NUCLEAR ROTATIONAL STATES. Kenneth W. Ford (Indiana Univ., Bloomington). Phys. Rev. 95, 1250-2(1954) Sept. 1.

Evidence concerning nuclear deformation from isotope shifts and from rotational states in even-even nuclei is compared for nuclei near neutron number 82. It is concluded that the moment of inertia of the rotational states is 4 ± 1 times greater than the theory predicts, if the nuclear radius is $1.20 \times 10^{-13} A^{1/3}$ cm, and if the interpretation of isotope shifts in terms of nuclear deformation is correct. (auth)

**6540**

NUCLEAR RADII FROM INELASTIC CROSS-SECTION MEASUREMENTS. G. P. Millburn, Wallace Birnbaum, W. E. Crandall, and L. Schecter (Univ. of California, Berkeley). Phys. Rev. 95, 1268-78(1954) Sept. 1.

Inelastic cross sections for high-energy protons, $He^3$ particles, and alpha particles accelerated in the 184-inch cyclotron were measured by an attenuation technique. All the cross sections vary as the square of the nuclear radius and indicate that if the nucleus has a fringe it increases as $A^{1/3}$. The derived value of the nuclear radius constant $a_0$ depends on the nuclear model and the particular bombarding particle. The effect of the nucleus is found to extend at least to a radius given by $a_0 = (1.68 \pm 0.04) \times 10^{-13}$ cm. Deuteron stripping cross sections were derived and found to vary approximately as the square root of the mass number. (auth)

**6541**

NUCLEAR CROSS SECTIONS AND THE SIZE OF THE NUCLEUS. Warren Heckrotte (Univ. of California, Berkeley). Phys. Rev. 95, 1279-81(1954) Sept. 1.

The recent experiments on the total inelastic cross sections for 190-Mev deuterons on various target nuclei demand a considerably larger nuclear radius than is usually accepted to explain the experimental results. It is shown that this result is not inconsistent with the total nuclear cross sections for 90-Mev neutrons if a nonsquare-well nuclear shape is taken. Taking for numerical simplicity a parabolic shape, the radius (measured to the edge of the distribution) that is obtained is $R = 1.6A^{1/3} \times 10^{-13}$ cm. The average radius is $R = 1.0A^{1/3} \times 10^{-13}$ cm. This result is compared with other determinations of the nuclear radius. (auth)

**6542**

NUCLEAR MAGNETIC RESONANCE IN A ROTATING FIELD. Claude Manus, Georges Béné, Pierre Denis, Richard Extermann, and Robert Mercier. Compt. rend. 239, 414-15(1954) Aug. 2. (In French).

The resonance conditions and relaxation effects of a rotating field are briefly interpreted with macroscopic magnetic resonance theory. (tr-auth)

**6543**

SPINS AND HYPERFINE SPLITTINGS OF $Ag^{111}$ AND $Cu^{64}$. Aaron Lemonick and Francis M. Pipkin (Princeton Univ., N. J.). Phys. Rev. 95, 1356-7(1954) Sept. 1.

A special atomic beam magnetic resonance apparatus was designed for measuring the spins and hyperfine splittings of $Ag^{111}$ and $Cu^{64}$. The arrangement of atomic optics is such that chromatic aberrations due to the Maxwellian distribution are compensated, giving an effective solid angle of $(5 \times 10^{-5})$ $4\pi$ steradians. The spin of $Cu^{64}$ was found to be 1, hyperfine splitting 1278 ± 20 Mc/sec, and $|\mu| = 0.40 \pm 0.05$ nm. The spin of $Ag^{111}$ is $\frac{1}{2}$, hyperfine splitting 2180 ± 100 Mc/sec, and $|\mu| = 0.144 \pm 0.007$ nm. (K.S.)

**6544**

GROUND STATE OF $Re^{186}$. Leo Koerts (Columbia Univ., New York). Phys. Rev. 95, 1358-9(1954) Sept. 1.

A reinvestigation of the decay scheme of $Re^{186}$ by a magnetic coincidence spectrometer indicates that an assignment of $1^-$ to the ground state should be retained. (K.S.)

**6545**

ENERGY LEVELS IN $Be^8$ FROM $Li^7(d,n)Be^8$. Carroll C. Trail and C. H. Johnson (Oak Ridge National Lab., Tenn.). Phys. Rev. 95, 1363-4(1954) Sept. 1.

**6546**

NUCLEAR MAGNETIC RESONANCE IN SOLID HYDROGEN WITH VARIOUS ORTHO-CONCENTRATIONS. Tadashi Sugawara, Yoshika Masuda, Teinosuke Kanda, and Eizo Kanda (Tohoku Univ., Sendai, Japan). Phys. Rev. 95, 1355-6 (1954) Sept. 1.

**6547**

VARIATION IN THE YIELD OF COULOMB EXCITATION FOR THE TWO FIRST ROTATIONAL LEVELS OF TANTALUM BY PROTONS OF ENERGY 1.2 TO 4.5 MEV. Roland Barloutaud and Tovy Grjebine. Compt. rend. 239, 491-3(1954) Aug. 9. (In French).

The Coulomb excitation of $Ta^{181}$ was studied with protons of 1.2 to 4.5 Mev. Gamma rays of 137, 166, and 303 kev were observed. The variations in yield for a thick target are in good agreement with theory. (tr-auth)

**6548**

INVESTIGATION OF THE NUCLEAR ISOMER $Se^{81*}$. G. M. Drabkin and L. I. Rusinov. Doklady Akad. Nauk S.S.S.R. 97, 417-20(1954) July 21. (In Russian).

The internal conversion electron spectrum of $Se^{81*}$ was determined and compared with the $Ag^{109*}$ spectrum. The coefficient of conversion for the K level was measured as $\alpha_K$ $Se^{81*} = 7.1 \pm 1.5$. The ratio of K to L conversion coefficients was $\alpha_K / 2_L = 4.0 \pm 0.2$. The spin of the isomeric nucleus $Se^{81*}$ is $\frac{7}{2}$ with positive parity. (J.S.R.)

## *NUCLEAR REACTORS*

**6549**

Brookhaven National Lab.

THE ENERGY-DEPENDENT BOLTZMANN EQUATION APPLIED TO CRITICALITY CALCULATIONS FOR BARE GRAPHITE-MODERATED REACTORS. J. A. Fleck. Aug. 1954. 7p. (BNL-298)

Application to the energy-dependent Boltzmann equation of the $\psi^1$ spherical harmonics approximation, which is reasonably accurate for a graphite moderator, yields a pair of simultaneous integral equations involving flux and current. As an alternative to a Taylor series expansion of the scattering densities involved in the integrals of these equations one can employ Lagrangian interpolation expansions, which, for bare reactors, convert the integral equations at once to difference equations. Application of a linear Lagrangian expansion yields a solution exact in the age-diffusion approximation but without involving the ambiguity of parameters characteristic of multigroup methods. (auth)

**6550**

Brookhaven National Lab.

INSTRUMENTATION AND CONTROL OF THE BROOKHAVEN NUCLEAR REACTOR. J. E. Binns. [1954?] 10p. (BNL-1902)

The special instrumentation necessary for the starting up and operation of a nuclear reactor is described. Special attention has been given to safety considerations. (auth)

**6551**

FAILURE AND DISASSEMBLY OF LOS ALAMOS FAST REACTOR. E. T. Jurney (Los Alamos Scientific Lab., N. Mex.). Nucleonics 12, No. 9, 28-30(1954) Sept.

Operations engaged in during the disassembly of the Los Alamos Fast Reactor following fuel element failure are described and illustrated photographically. Disassembly methods described led to a minimum of danger from radiation exposure and from plutonium poisoning. (C.H.)

**6552**

EVALUATING REACTOR HAZARDS FROM AIRBORNE FISSION PRODUCTS. Russell B. Mesler and Lawrence C. Widdoes (Univ. of Michigan, Ann Arbor). Nucleonics 12, No. 9, 39-41(1954) Sept.

Methods are presented for calculating maximum possible hazards from a nuclear incident in which all the radioactive contaminants from the reactor are dispersed into the air. Procedures are described for estimating the contaminant concentration downwind from the source, the external doses, the inhalation doses, and doses from fall-out. (C.H.)

**6553**

HOW TO USE THE FISSION-SPECTRUM FORMULA IN REACTOR CALCULATIONS. R. L. Murray, M. R. Keller, and D. E. Hostetler (North Carolina State Coll., Raleigh). Nucleonics 12, No. 9, 64-5(1954) Sept.

Energy-distribution measurements of $U^{235}$ fission neutrons are shown to accurately fit a semi-empirical formula. The relation can be used to determine values of the effective slowing-down length of neutrons in a reactor moderator and to evaluate the average diffusion coefficient of epithermal neutrons in a reactor moderator and to evaluate the average diffusion coefficient of epithermal neutrons for group-diffusion theory. The spectrum formula is derived, useful formulas for calculations are presented, and tests of an approximate procedure involving replacement of the spectrum by a 2-Mev monoenergetic source are presented. (C. H.)

**6554**

NUCLEAR CONSTANTS IN REACTOR DESIGN. Hans A. Bethe (Cornell Univ., Ithaca, N. Y.). Nucleonics 12, No. 9 70-2(1954) Sept.

Nuclear constants to be considered in the design of reactors are reviewed. (C.H.)

**6555**

POWER FROM THE ATOM—IT'S ALMOST HERE. Chem. Eng. 61, No. 9, 118-26(1954) Sept.

Designs, cost factors, and chemical processing of reactor fuels for various proposed commercial nuclear power plants are discussed. The design of the Westinghouse-Duquesne 60,000-kev pressurized water reactor, using ordinary water at 2,000 psi which moderates the reactor and transfers heat to exchangers where steam is generated at 600 psia, is described. (J.A. G.)

## *NUCLEAR TRANSFORMATION*

**6556**

STUDY OF THE REACTION $Al^{109}(\gamma,\alpha)Rh^{105}$. Hubert de Laboulaye and Jacqueline Beydon. Compt. rend. 239, 411-14(1954) Aug. 2. (In French).

The activation curve of the reaction $Ag^{109}(\gamma,\alpha)Rh^{105}$ was obtained from betatron radiation. The known data from the activation curve of $Ni^{58}(\gamma,n)Ni^{57}$ was used to calibrate the results. The $Rh^{105}$ was extracted by chemical means. The effective cross section obtained was found to be much larger than that predicted by statistical evaporation theory. (tr-auth)

**6557**

GAMMA RADIATION FROM THE PROTON BOMBARDMENT OF OXYGEN. J. B. Warren, K. A. Laurie, D. B. James, and K. L. Erdman (Univ. of British Columbia, Vancouver). Can J. Phys. 32, 563-70(1954) Sept.

The nuclear gamma radiation following the non-resonant capture of a proton in $O^{16}$ has been studied with protons of energies from 800 kev to 2.1 Mev and found to consist of three components. The main transition goes, via a gamma ray of energy that varies with proton bombarding energy, to the $J = 1/2 +$ state of $F^{17}$. This state, 487 kev above the ground state, radiates directly to the ground state. In addition there is a weaker direct radiative transition from the capture configuration to the ground state. At energies above $E_p$ = 1.8 Mev, oxide targets bombarded with protons give rise to a radiation of 873 kev attributed to the presence of the $O^{17}$ isotope via the reaction $O^{17}(p,p')O^{17*}$, the radiation corresponding to the transition from the first excited state of $O^{17}$ to the ground state. (auth)

**6558**

PRODUCTION OF $I^{124}$ BY THE DEUTERON BOMBARDMENT OF TELLURIUM. T. Hall, M. Siegal, L. M. Sharpe, and D. Pressman (Sloan-Kettering Inst., New York). Phys. Rev. 95, 1208(1954) Sept. 1.

We have observed a nuclear reaction not previously reported: the production of $I^{124}$ by the deuteron bombardment of tellurium. The $I^{124}$ was identified by decay and gamma-ray pulse-height studies using a well-type scintillation counter. We report also some observations on the relative amounts of the different iodine isotopes produced by the bombardment. (auth)

**6559**

URANIUM PHOTOFISSION YIELDS. Roman A. Schmitt and Nathan Sugarman (Univ. of Chicago). Phys. Rev. 95, 1260-7 (1954) Sept. 1. (cf. NSA 7-2714).

The photofission yield-mass curve of natural uranium for 48-Mev x rays was determined radiochemically. Isolation of selected peak and trough fission products at various maximum x-ray energies, 7, 10, 16, 21, 48, 100, and 300 Mev showed that the peak-to-trough ratio decreased from 300 to 4 as the maximum x-ray energy increased from 7 to 300 Mev. The observed photofission yield curves may be quantitatively interpreted as the superposition of two components, a low-energy asymmetric (double-humped) curve and a high-energy single-humped curve. The average cross section for symmetric fission for photons in the energy range 16 to 300 Mev is about 7 millibarns. (auth)

**6560**

PHOTODISINTEGRATION OF DEUTERIUM BY 165-MEV X-RAYS. E. A. Whalin, Jr. (Univ. of Illinois, Champaign). Phys. Rev. 95, 1362-3(1954) Sept. 1.

The angular distribution of photoprotons from 165-Mev x irradiation of liquid $D_2$ was measured for average c.m. energies of 62.9 and 130.6 Mev. The two distributions are compared with a curve of the form $(A + B \sin^2\theta)(1 + 2\beta \cos\theta)$. The $\sin^2\theta$ component, large at 62.9 Mev, was not appreciable at 130.6 Mev. At the latter energy, the angular distribution is characterized by large fore and aft asymmetry, presumably due to a retardation effect. Several implications of the observed results are discussed. (K.S.)

## *PARTICLE ACCELERATORS*

**6561**

[European Council for Nuclear Research]

THEORETICAL LOSSES IN A HELIX WITH SHIELD AND SUPPORT. Kjell Johnsen. Aug. 17, 1954. 22p. (CERN-PS/KJ-27)

Losses affecting the shunt impedance and other electrical characteristics of a helical accelerating structure in a high-energy linear accelerator are discussed. The influence of the coaxial shield and supporting structure are examined in detail. It is concluded that minor theoretical advantages are offered by the helix configuration over the Alvarez type, at least in the 30 Mev range. (K.S.)

**6562**

[European Council for Nuclear Research]

ON THE VALIDITY OF PERTURBATION THEORY AS A HELP FOR NUMERICAL INTEGRATION OF NON-LINEAR EQUATIONS OF MOTION. Aug. 1954. 26p. (CERN-PS/RH-2)

A theory is developed for obtaining numerical solutions for the non-linear equations of motion in an alternating-gradient proton synchrotron. The validity of approximate solutions by simple perturbation calculations is investigated, based on the absence of strong non-linearities for particles in such an accelerator design. The steps are expressed in the form of transfer matrices, suitable for solution by electronic computers. (K.S.)

**6563**

Radiation Lab., Univ. of Calif., Berkeley

THE BEVATRON 9.9-MEV PROTON LINEAR ACCELERATOR. Bruce Cork. July 1954. 35p. Contract W-7405-eng-48. (UCRL-2385)

The Bevatron requires an intense source of high-energy protons. The machine should accept monoenergetic protons for a duration of approximately 500 μsec once every 6 sec. To satisfy the requirements of small loss due to scattering by the gas in the accelerating chamber, a 9.9-Mev linear accelerator has been built and operated. A 500-kv Cockcroft-Walton generator is used to inject 2-ma peak proton current into the linear accelerator. Focusing grids

intercept approximately half of the injected beam. Additional losses, including radial defocusing and acceptance phase angle, result in a peak accelerated beam of 140 μa. The energy spread of the accelerated protons has not been measured, but an upper limit is less than ±30 kev. (auth)

**6564**

Radiation Lab., Univ. of Calif., Berkeley
PLACEMENT OF THE SYNCHROTRON BEAM ON AN INTERNAL TARGET. [PART] 1. Warren Fenton Stubbins. Apr. 7, 1954. 13p. Contract W-7405-eng-48. (UCRL-2543)

High-energy electrons in a synchrotron may be placed on an internal target within one microsecond by using the forced radial oscillations that occur at n = 0.75 in the presence of a first harmonic azimuthal variation of the magnetic field. The effect of the first harmonic in general and at n = 0.75 is examined. The requirements for changing the radial field gradient from n = 0.67 to n = 0.75 are determined. An operating cycle is suggested. (For Part II of this series see UCRL-2600.) (auth)

**6565**

Radiation Lab., Univ. of Calif., Berkeley
PLACEMENT OF THE SYNCHROTRON BEAM ON AN INTERNAL TARGET. [PART] 2. Warren Fenton Stubbins. May 20, 1954. 7p. Contract W-7405-eng-48. (UCRL-2600)

An alternate method of placing the internal beam of the synchrotron on an internal target in a very short time, one microsecond, is proposed. An earlier study (UCRL-2543) considers the radial blow-up of the beam by the azimuthal variation of the magnetic field of the synchrotron at the radial field gradient specified by n = 0.75. The present system proposes the application of a radiofrequency electric field resonant with the radial oscillations producing blow-up at the unmodified field gradient specified by n = 0.67. The axial and radial oscillation frequencies are not commensurable; thus resonance blow-up is avoided in the axial direction. (For Part I of this series see UCRL-2543.) (auth)

## *RADIATION ABSORPTION AND SCATTERING*

**6566**

Hanford Works
NEUTRON SCATTERING FROM THE WALLS AND AIR OF A LABORATORY. D. W. Glasgow. June 9, 1954. 20p. Contract W-31-109-Eng-52. (HW-32086)

It was found that if a small neutron source was separated from a scattering body such as a floor by a distance comparable to the size of the detector, or more, then the effects of scattering could be determined as follows: a plot is made of the counts per minute (c/m) multiplied by the square of the distance to the source ($r^2$) versus the distance to the source. This is then extrapolated to r = 0. The value of $r^2 \times c/m$ at this point represents the contribution from unscattered neutrons; the excess over this value at other points is due to scattered neutrons. This provides a method for measuring the scattering in an experimental arrangement, for calibrating an instrument with a source of known emissions, or for estimating the emission of an unknown source using a calibrated instrument. A measurement of the scattering from the surrounding atmosphere was made by suspending the source and detector sufficiently high above the ground so that scattering from the ground was negligible. This flux was found to be in agreement with the formula $f_a = \pi/16\ Q/\lambda r$, where Q is the number of neutrons per sec emitted by the sources and λ is the mean free path in air. Subtracting this component from the total scattered flux gave that due to the room boundaries. In the center of a room this was found to be given approximately by the formula $f_w = Q/3\pi h^{2-}$, where h is the distance to the room walls. (auth)

**6567**

Radiation Lab., Univ. of Calif., Berkeley
POLARIZATION OF NEUTRONS PRODUCED BY BOMBARDING TARGETS WITH 285 MEV POLARIZED PROTONS. Hugh Bradner and Robert Donaldson. July 12, 1954. Contract W-7405-eng-48. (UCRL-2627(rev.))

Neutron assymetries resulting from the bombardment of C, Be, and Li targets by 285-Mev polarized protons are plotted as a function of neutron angle. A proton beam of 65% polarization was obtained by scattering a cyclotron beam in an internal Be target. A non-zero neutron polarization at 90° (c.m.) indicates the presence of both odd and even terms in the scattering analysis. (K.S.)

**6568**

THE ELASTIC SCATTERING OF 7.86-MEV DEUTERONS BY CARBON 12. J. Catalá, F. Senent, and J. Casanova. Anales real soc. espan. fis. y quim. (Madrid) Ser. A 50, 145-50 (1954) July-Aug. (In Spanish).

The angular distribution of the 7.86-Mev deuterons elastically scattered by $C^{12}$ has been determined and plotted, together with the results obtained from the well known Rutherford scattering formula, to show the special interaction deuteron-$C^{12}$. (auth)

**6569**

THE PHOTONEUTRON AND PHOTOPROTON CROSS SECTIONS OF SILICON AND MAGNESIUM. L. Katz, R. N. H. Haslam, J. Goldemberg, and J. G. V. Taylor (Univ. of Saskatchewan, Saskatoon, Canada). Can. J. Phys. 32, 580-92(1954) Sept.

The (γ,n) and (γ,p) cross sections were measured as a function of photon energy in a number of isotopes. They were found to have the resonance shapes characteristic of photonuclear reaction for which the pertinent data are summarized in the table.

| Isotope | Reaction | Threshold (Mev.) | Position of peak (Mev.) | Maximum cross (mbarns) | Integrated cross section (Mev-barn) |
|---|---|---|---|---|---|
| $Mg^{25}$ | (γ,n) | 7.2 | ~13 | ~14 | ~0.05 |
| | (γ,p) | 12.1 | 20.5 | 27 | 0.12 |
| $Mg^{26}$ | (γ,n) | 11.1 | ~17 | ~30 | ~0.09 |
| | (γ,p) | 14.3 | 22 | 25 | 0.07 |
| $Si^{29}$ | (γ,n) | 8.5 & 10.6 | 15 | 23 | 0.096 |
| +$Si^{30}$ | (γ,p) | 12.3 & 12.9 | 21 | 32 | 0.23 |

In view of the fact that in each isotope the threshold for the (γ,p) reaction is higher than that for the (γ,n) reaction it is surprising to find the maximum (γ,p) cross section to be at least equal to the maximum (γ,n) cross section, while peaking at about 6 Mev higher energy. These results are discussed in some detail. (auth)

**6570**

THE (γ,n) AND (γ,p) CROSS SECTIONS OF ARGON$^{40}$. D. McPherson, E. Pederson, and L. Katz (Univ. of

Saskatchewan, Saskatoon, Canada). Can. J. Phys. 32, 593-8 (1954) Sept.

The (γ,n) and (γ,p) cross sections in $A^{40}$ have been measured as a function of photon energy from threshold to 24 Mev. The (γ,n) cross section was found to have a peak value of 38 mb at 20 Mev and an integrated cross section of 0.35 Mev-barn. These values for the (γ,p) cross section were found to be 120 mb at >25 Mev and 0.54 Mev-barn respectively. In spite of the higher (γ,p) threshold, it was found that the two cross sections were equal at 19.5 Mev and above this energy the (γ,p) cross section became larger. This interesting result is discussed. (auth)

**6571**

ON THE PATH OF LIGHT AND HEAVY NUCLEI IN A PHOTOGRAPHIC EMULSION PRODUCED BY PROTONS OF 340 MEV. Pierre Cüer and Jean Combe. Compt. rend. 239, 351-3(1954) July 26. (In French).

Experimental results on the production of nuclear fragments by passage of a 340-Mev proton through a photographic emulsion agree with a cascade process analyzed by the Monte Carlo method. The model is not sensitive to nuclear radiation, but the influence of nucleon movement is easily measurable. For light nuclei, a model of independent nucleons is inexact, and the hypothesis of instantaneous subshells appears essential. (tr-auth)

**6572**

THE ELASTIC SCATTERING OF 18.5-MEV PROTONS BY NUCLEI. I. E. Dayton and P. C. Gugelot (Princeton Univ., N. J.). Phys. Rev. 94, 785(1954) May 1.

The absolute differential cross section for the elastic scattering of 18.5-Mev protons has been measured for aluminum at 35 angles between 15 degrees and 172 degrees. The statistical error at each point is less than 3 percent. The protons are detected by a sodium iodide crystal with about 2.3 percent energy resolution. Protons to the lowest level in $Al^{27}$, which is at 0.845 Mev, are clearly resolved from the elastic group. The angular width of the counter is about one-third of a degree. The cross section shows a very sharp minimum at 44 degrees, with maxima at 62 degrees, 123 degrees, and apparently at 180 degrees. Calculations using the optical model with a potential V = (−45 − 21i) Mev follow the general trend of the data, but they completely fail to reproduce its detailed structure. (auth)

**6573**

BOHR'S THEORY OF ENERGY LOSSES OF MOVING CHARGED PARTICLES. Jacob Neufeld (Oak Ridge National Lab., Tenn.). Phys. Rev. 95, 1128-33(1954) Sept. 1.

The stopping power of a particle having charge $Z_{eff}\epsilon$ and moving with velocity v has been determined by Bohr for $k = 2Z_{eff}\epsilon^2/\hbar v$ and $n_s = 2v/\mu_s > 2$, where $\mu_s$ is the velocity of the orbital electron that is effective in stopping the particle. Bohr's results are formulated differently for $\kappa/\eta_s < 1$ and $\kappa/\eta_s > 1$ and are based on an orbital picture of the processes involved. An alternative method has been developed in which the space surrounding the particle track has been subdivided into three regions: (a) the region of validity of the Rutherford formula (adjacent to the track), (b) the intermediate region involving large perturbations for which no adequate theory exists at the present time, and (c) the region of validity of the quantum perturbation theory (the most remote from the track). By extrapolating the formulas valid in regions (a) and (c) into the region (b), the contribution to the stopping power due to the region (b) has been estimated, and adding to it the contribution due to the regions (a) and (c) an expression has been derived from the total stopping power that is applicable whenever $\kappa > 1$ and $\eta_s > 1$. This expression has a wider region of applicability than the corresponding Bohr's formula since the latter can be used only for $\kappa \ll \eta_s^3$ if $\kappa/\eta_s > 1$. The physical picture used for deriving this expression is somewhat similar to the one used by Bohr for $\kappa/\eta_s < 1$ but is different from the one used by Bohr for $\kappa/\eta_s > 1$. (auth)

**6574**

MAGNETIC NEUTRON DIFFRACTION FROM $Fe_3O_4$. A. W. McReynolds and T. Riste (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). Phys. Rev. 95, 1161-7 (1954) Sept. 1.

By neutron diffraction intensity measurements, the spin alignment structure has been studied from room temperature to above the Curie point in an unmagnetized (random domain orientation) crystal of $Fe_3O_4$. Intrinsic magnetization is found to follow approximately the Weiss theory and to go to zero at a sharply defined Curie point, where domain structure disappears. An additional diffuse component of the magnetic Bragg peaks is observed to be independent of external fields and indicates transient short-range ordering of spins, which reaches a sharp maximum at the Curie point but exists at both higher and lower temperatures. (auth)

**6575**

ELASTIC SCATTERING OF INTERMEDIATE-ENERGY ALPHA PARTICLES BY HEAVY NUCLEI. George W. Farwell and Harvey E. Wegner (Univ. of Washington, Seattle). Phys. Rev. 95, 1212-17(1954) Sept. 1.

The deflected alpha-particle beam of the University of Washington 60-inch cyclotron has been used to study the elastic scattering of 13- to 42-Mev alpha particles by Ag, Ta, Pb, and Th at 60°. The alpha-particle energy was decreased in steps of approximately 1 Mev by placing remotely controlled absorbers in the cyclotron beam. Elastically scattered alpha particles were selected and counted by a differential-range coincidence proportional-counter telescope. Up to a certain critical energy $E_0$, which increases with Z, the cross section for each element decreases with increasing alpha-particle energy in agreement with the Rutherford formula. At higher energies, the dependence is given by the empirical formula $\sigma(E) = \sigma(E_0) \exp\{-K(E - E_0)\}$. The slope parameter K is about 0.26 $Mev^{-1}$ and decreases slightly as Z increases. Intepretation of results in terms of a semiclassical strong absorption model leads to values of the sum of nuclear radius and alpha-particle radius best fitted by the empirical formula $D = (1.50A^{1/3} + 1.4) \times 10^{-13}$ cm. (auth)

**6576**

THEORY OF ELASTIC SCATTERING OF ALPHA PARTICLES BY HEAVY NUCLEI. J. S. Blair (Univ. of Washington, Seattle). Phys. Rev. 95, 1218-22(1954) Sept. 1.

A semiclassical model is used to interpret recent experiments of Farwell and Wegner on the elastic scattering of 13 to 42 Mev alpha particles by heavy nuclei. In this model the outgoing lth partial wave is assumed to vanish if the corresponding classical turning point is less than the radius of the nucleus plus that of the alpha particle; otherwise, it has a phase characteristic of pure Coulomb scattering. The theory predicts that the sum of nuclear and alpha-particle radii is approximately equal to the classical apsidal distance evaluated at the energy for which the experimental cross section is one-quarter of the corresponding Rutherford cross section. (auth)

**6577**

TIME-OF-FLIGHT MEASUREMENTS ON THE INELASTIC SCATTERING OF 14.8-MEV NEUTRONS. Gerard K. O'Neill (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 95, 1235-45(1954) Sept. 1.

Measurements have been made of the energy spectra of neutrons inelastically scattered from 14.8 Mev into the interval 0.5–4 Mev. Carbon, aluminum, copper, tin, and lead scatterers were used. 100-kev deuterons were extracted from a cyclotron and allowed to strike a target of tritium absorbed in zirconium. The resulting reaction $T^3(d,n)He^4$ (17.7 Mev in the center-of-mass system) yielded a 14.8-Mev neutron accompanied by a recoil 3-Mev alpha particle. A scintillation counter within the vacuum system, subtending a solid angle of $4\pi/100$ at the target, detected recoil alpha particles with ~100 percent efficiency, delivering a fast signal whenever a neutron started on a path within a cone chosen to avoid scattering material for a distance of several meters. Within the cone and close to the target a scatterer was placed. The inelastically scattered neutrons emerged from the scatterer with approximate isotropy, while few elastically scattered neutrons were deflected through large angles. A proton-recoil neutron counter placed at ~90° to the cone axis was thus prevented from detecting almost all undesired neutrons. The distance from the scatterer to the counter was 50 to 100 centimeters, and neutron energies were obtained from the measured flight times over this path length, with the recoil alpha signal serving as a time zero. The flight times, which were from 20 to 65 mμsec, were measured by a time analyzer having nine $4.7 \times 10^{-9}$ second channels, recording directly on mechanical registers. Experimentally, neutron energies after scattering could be approximated by number/unit energy $E = E \exp(-E/T)$ with T, the "nuclear temperature" in Mev obtained from the raw data being: Pb, 0.75; Sn, 0.62; Cu 0.84; Al, 1.06; C, 0.93. These results are in general agreement with photographic plate data. The experimentally observed angular distributions were isotropic within the limits of error of ~15 percent. Over-all limits of error of ±15 percent in the nuclear temperatures are assigned. (auth)

**6578**

SCATTERING OF 1.32-MEV NEUTRONS BY PROTONS. C. L. Storrs and D. H. Frisch (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 95, 1252-9(1954) Sept. 1.

The total cross sections of polyethylene and graphite for scattering of neutrons of $1.315 \pm 0.003$ Mev have been measured and are $\sigma(CH_2) = (9.542 \pm 0.035) \times 10^{-24}$ cm$^2$ and $\sigma(C) = (2.192 \pm 0.020) \times 10^{-24}$ cm$^2$. From these the hydrogen cross section is $\sigma(H) = (3.675 \pm 0.020) \times 10^{-24}$ cm$^2$. If the best current values of the binding energy of the deuteron, the coherent scattering length, and the epithermal cross section are used, the singlet effective range in the shape-independent approximation is $(2.4 \pm 0.3) \times 10^{-13}$ cm. This is to be compared with the proton-proton singlet effective range of $(2.7 \pm 0.1) \times 10^{-13}$ cm. (auth)

**6579**

SMALL-ANGLE p-p CROSS SECTIONS AND POLARIZATION AT 300 MEV. O. Chamberlain, G. Pettengill, E. Segrè, and C. Wiegand (Univ. of California, Berkeley). Phys. Rev. 95, 1348-9(1954) Sept. 1.

The proton-proton differential scattering cross section at 300 Mev has been investigated at angles less than 20 degrees in the c.m. system. Previously encountered difficulties with the high background were treated by taking unusual care in defining the beam trajectory with a system of counters in coincidence. The asymmetry of the beam scattered by a liquid-$H_2$ target was obtained from left- and right-hand scatterings, and the polarization then calculated from previous calibration of the proton beam. The results for small angles are found to fit the curve obtained by a Fourier analysis of data at larger angles. (K.S.)

**6580**

PROTON-PROTON SCATTERING EXPERIMENTS AT 170 AND 260 MEV. Owen Chamberlain and John D. Garrison (Univ. of California, Berkeley). Phys. Rev. 95, 1349-50 (1954) Sept. 1.

The differential proton-proton scattering cross section was measured at 170 and 260 Mev, for laboratory scattering angles of 4.4 to 40°. The results are essentially in agreement with previous work. Within the accuracy of the experiment, the differential cross sections were the same at both energies. (K.S.)

**6581**

SMALL ANGLE PROTON-PROTON SCATTERING AT 330 MEV. David Fischer and Gerson Goldhaber (Univ. of California, Berkeley). Phys. Rev. 95, 1350-1(1954) Sept. 1.

The proton-proton scattering cross section at 330 Mev has been measured at 2.2 to 14° lab angles, where Rutherford and nuclear scattering interferences are to be expected. Highly-collimated protons, scattered from a liquid-$H_2$ target, were detected in G-5 nuclear emulsions placed on the left and right side of the beam. The absolute cross section determination gives $3.8 \pm 0.25$ mb/sterad for angles above 20° (c.m.), in good agreement with the recent Berkeley value of $3.72 \pm 0.15$ mb/sterad. A plot of the experimental points obtained is considered to consist of a cross section made up of separate terms due to Rutherford, nuclear, and interference effects. The difference between these points and curve plotted from Møller's theory taking account of Rutherford and nuclear scattering only, is interpreted as representing the interference effect. On this assumption, the data indicate a net effect from interference in the region of 6 to 14° (c.m.). (K.S.)

**6582**

EQUILIBRIUM CHARGE DISTRIBUTION OF STRIPPED 26-MEV NITROGEN IONS. H. L. Reynolds and A. Zucker (Oak Ridge National Lab., Tenn.). Phys. Rev. 95, 1353(1954) Sept. 1.

The deflected triply-charged nitrogen-ion beam from the ORNL cyclotron is passed through thin foils of Al or Formvar, and the stripped 26-Mev ions are analyzed by the fringing field of the cylotron into its charge components. The relative abundance of charge states after passing through a thin foil is $N^{7+} = 0.38$, $N^{6+} = 0.46$, $N^{5+} = 0.16$, and $N^{4+} < 0.01$. The average charge thus obtained is 6.2e, in agreement with previous measurements. (K.S.)

**6583**

RESONANCE ABSORPTION OF GAMMA RADIATION BY $O^{16}$ NUCLEI. J. G. Campbell (Univ. of Melbourne, Australia). Phys. Rev. 95, 1357-8(1954) Sept. 1.

The $O^{16}(\gamma,n)O^{15}$ reaction was investigated by irradiating $O^{16}$ with the γ radiation produced by the $Li^7(p,\gamma)Be^8$ reaction. A peak in the activation per photon at $510 \pm 10$ kev incident proton energy was observed, and it is concluded that the peak corresponds to a photon resonance of $17.721 \pm 0.010$ Mev in $O^{16}$, with an estimated width of 20 kev. (K.S.)

**6584**

POLARIZATION OF FAST NEUTRONS FROM NUCLEAR REACTIONS. Harvey B. Willard, Joe K. Bair, and Joe D. Kington (Oak Ridge National Lab., Tenn.). Phys. Rev. 95, 1359-60(1954) Sept. 1.

The polarization of fast neutrons elastically scattered by $O^{16}$, having a $P_{\frac{3}{2}}$ resonance at 435 kev which interferes with the $S_{\frac{1}{2}}$ potential scattering, is studied. $Li^7$ was bombarded by 5.5-Mev protons, and the resultant neutrons emitted at 42° were elastically scattered through ± 90° by $H_2O$. The results are graphically presented, and are consistent with known level parameters of the level in $O^{17}$, and a nearly constant value of $P_1(42°) = 0.50 \pm 0.04$ for the $Li^7(p,n)Be^7$ reaction in this region. (K.S.)

## *RADIATION EFFECTS*

**6585**

Illinois Inst. of Tech.

INVESTIGATION OF IMPERFECTIONS IN SOLIDS: COLOR CENTERS IN SODIUM CYANIDE CRYSTALS. SUMMARY REPORT. Giovanni Isetti and Theodore J. Neubert. July 17, 1954. 60p. Contract AT(11-1)-90. (COO-147)

Sodium cyanide single crystals were prepared by melting previously purified starting material in a Pyrex glass tube and slowly cooling the fused mass in the natural temperature gradient of a vertical furnace. The absorption spectrum of the crystals was measured at room temperature and at 0°C. At room temperature the absorption curves presented the general characteristic of increasing strongly as the low wavelength limit of the spectrophotometer was approached. The absorption in the spectral region 2400 to 2100 A was tentatively assigned to impurity ions; in the spectral range 4000 to 2400 A the absorption by impurity ions was thought to be masked by a light scattering effect. At 0°C the curves were considerably enhanced throughout the whole spectral range investigated. This increase in absorption was attributed to light scattering, by scattering centers large as compared with the wavelength of the incident light. The absorption spectrum of sodium cyanide crystals irradiated with x rays was also studied at 22, 16, and 30.4°C. Two sharp absorption bands were found located at 5100 A (I-band) and at 3600 A (II-band). Both bands were observed to be very unstable, bleaching rapidly in the dark at room temperature. The I-band was tentatively identified as an F-band, and its spontaneous bleaching was attributed to the occasional reorientation of the $CN^-$ ions around the trapped electron. Both bands did not bleach completely, a small portion of them persisting indefinitely. The intensity of these two residual bands was found to depend on the time of x irradiation, and their presence was evidenced by a yellow coloration of the sample. As a result of x irradiation a strong and permanent enhancement in absorption occurs on the high energy side of the two residual bands. The absorption spectrum of crystals x rayed and measured at 0°C was also studied, and a weak absorption band was found, located at 5200 A. The intensity of this band was found to be independent of time. (auth)

**6586**

NEUTRON IRRADIATION OF INDIUM ANTIMONIDE. J. W. Cleland and J. H. Crawford, Jr. (Oak Ridge National Lab., Tenn.). Phys. Rev. 95, 1177-82(1954) Sept. 1.

Hall coefficient and resistivity measurements as a function of temperature have been made on both n- and p-type single crystalline samples of InSb after successive periods of exposure in the Oak Ridge graphite reactor. Effects due to the introduction of Sn, a donor impurity, were minimized by shielding the specimens from those neutrons leading to In transmutation with cadmium and indium foil. The results of these measurements indicate conclusively that lattice defects produced by fast-neutron bombardment convert p-type InSb to n type. In addition they appear to act as shallow electron traps in n-type material. The mobility of carriers is markedly decreased by the bombardment-produced defects, but this decrease in mobility, as well as changes in carrier concentration resulting from bombardment-produced energy states can be essentially completely removed by appropriate heat treatment. An attempt has been made to correlate the various possible simple defects expected in the InSb structure with the nature of energy levels introduced by fast-neutron bombardment. (auth)

## *RADIOACTIVITY*

**6587**

Brookhaven National Lab.

THE ROLE OF INTERNAL CONVERSION IN THE STUDY OF ISOMERIC TRANSITION. M. Goldhaber. [June 24, 1954]. 3p. (BNL-1932)

A short review of the field of internal conversion is presented. (J.S.R.)

**6588**

RELATIVE DIFFERENCES IN THE $H_2O^{18}$-CONTENT OF NATURAL WATERS. Peter Baertschi. Translated from Helv. Chim. Acta 36, 1352-69(1953). 16p. (AERE-Trans-11/3/5/414)

The relative differences in the $O^{18}/O^{16}$ ratio of 91 waters of natural origin were measured mass spectrographically and compared with Basle conductivity water used as a standard. The procedure used for the isotope analysis is described. Data are presented from 12 precipitations, 9 surface waters, 54 underground waters including 51 Swiss mineral and thermal waters, and 16 waters obtained by dehydration of minerals. The results are compared with corresponding analyses carried out earlier. (C.H.)

**6589**

DECAY OF $Pt^{191}$. E. P. Tomlinson and R. A. Naumann (Princeton Univ., N. J.), and J. W. Mihelich (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 94, 794(1954) May 1.

Samples of 3-day $Pt^{191}$ (and 4-day $Pt^{193m}$) have been obtained by bombarding Ir with deuterons in the Brookhaven cyclotron and studied with a gray-wedge coincidence analyzer and 180° photographic spectrographs at Brookhaven and with the Princeton high-resolution Siegbahn-type spectrometer. We find the γ rays of 82, 96, 125, (135 from $Pt^{193m}$), 172, 179, 268, 350, 360, 409, 456, and 540 kev as reported by Swan, Portnoy, and Hill. Conversion electrons which would give rise to the 62-kev transition reported by these authors, we believe to be Auger electrons. We also find evidence for γ rays of 42, 220, approximately 620, and possibly 158 kev. From the energies, the conversion electron and γ-ray intensities, and the coincidence measurements of these γ rays, a self-consistent energy-level scheme can be proposed for $Ir^{191}$. Work is continuing on these measurements. (auth)

**6590**

OBSERVATION ON THE 4.43-MEV GAMMA RAYS FROM

$C^{12}$. W. R. Mills, Jr., and R. J. Mackin, Jr. (California Inst. of Tech., Pasadena). Phys. Rev. 95, 1206-8(1954) Sept. 1.

A scintillation spectrometer has been used for "fore and aft" measurements to demonstrate that the 4.43-Mev gamma radiation from $Be^9(\alpha,n\gamma)C^{12}$ exhibits a Doppler shift as the result of motion of the emitting nucleus. This implies a lifetime for the $C^{12}$ excited state less than $3 \times 10^{-13}$ second. The Compton electron spectrum from a thin converter has been studied in a magnetic lens spectrometer to produce a value for the level excitation of 4.425 ± 0.020 Mev. The spectrum of internal pairs has been found to agree most closely (to 5 percent) with the (known) assignment of the radiation as electric quadrupole. (auth)

**6591**

GAMMA-RAY SPECTRUM OF $Ac^{228}$. Harold C. Box and G. Stanley Klaiber (Univ. of Buffalo, N. Y.). Phys. Rev. 95, 1247-9(1954) Sept. 1.

The gamma radiation from a radioactivity pure source of $Ac^{228}$ has been studied using a NaI scintillation spectrometer. Gamma rays of 0.098, 0.127, 0.336, 0.410, 0.458, 0.907, 0.965, 1.587, 0.155, 0.220, 0.278, and 0.790 Mev are indicated, of which the last four are previously unreported. A double scintillation spectrometer is described which was used to investigate gamma-gamma coincidences. A decay scheme for $Ac^{228}$ is suggested. (auth)

**6592**

RECOIL SPECTRUM IN THE BETA DECAY OF $Ne^{19}$. W. Parker Alford and Donald R. Hamilton (Princeton Univ., N. J.). Phys. Rev. 95, 1351-3(1954) Sept. 1.

An apparatus has been designed for identifying the Fermi component of the electron recoils emitted from $Ne^{19}$ at nearly 180° in time coincidence with the positrons. Values of the electron-neutrino angular correlation coefficient $\alpha$, as a function of counting rate, were calculated for the best least squares fit to the data. The weighted mean of six runs yields $\alpha = -0.8 \pm 0.4$, indicating that the Fermi part of the $\beta$ interaction is scalar. (K.S.)

**6593**

DECAY SCHEME OF $Pb^{204m}$. V. E. Krohn and S. Raboy (Argonne National Lab., Lemont, Ill.). Phys. Rev. 95, 1354-5(1954) Sept. 1.

**6594**

GEOCHRONOLOGICAL SIGNIFICANCE OF EXTINCT NATURAL RADIOACTIVITY. Truman P. Kohman (Carnegie Inst. of Tech., Pittsburgh, Penna.). Science 119, 851-2(1954) June 11.

The possibilities of determining the occurrence and the potential significance of extinct radioactivity in determining the time of ancient geologic events associated with the formation of certain minerals or geochemical phases are discussed briefly. (C.H.)

## *SHIELDING*

**6595**

HOW TO SHIELD REACTOR BEAMS. W. P. Stinson (Hanford Works, Richland, Washington). Nucleonics 12, No. 9, 50-4(1954) Sept.

Neutron and $\gamma$-ray absorption in boron-loaded paraffin and in water was measured using a Hanford reactor beam as the source. Shielding design procedures based on attenuation curves derived from the flux distribution measurements are presented. (C.H.)

## *SPECTROSCOPY*

**6596**

THE STRUCTURE OF THE SPECTRUM OF Nb II IN THE EXTREME ULTRAVIOLET. Laura Iglesias (Univ. of Madrid, Spain). Anales real soc. espan. fis. y quim. (Madrid) Ser. A 50, 135-44(1954) July-Aug. (In Spanish).

New measurements in the region 1579 to 2211 A of the vacuum spark spectrum of niobium have been made. Twenty new atomic energy odd levels have been found. The following spectral terms have been identified among them: a $S^e$ quintet, two $G^e$ triplets, and three $F^e$, $G^e$, $H^e$ singlets. The 330 new lines of which 156 are classified with the Humphreys and Meggers levels and 184 with the levels now identified are tabulated. The greatest part of these new levels belong to the electronic configuration $4d^25s5p$. (auth)

**6597**

CORRECTED VALUES OF TUNGSTEN K-SERIES X-RAY WAVELENGTHS WITH THE 2-METER CURVED CRYSTAL DIFFRACTION SPECTROMETER. Philip Snelgrove, Jassim El-Hussaini, and Jesse W. M. DuMond (California Inst. of Tech., Pasadena). Phys. Rev. 95, 1203-4(1954) Sept. 1.

Certain minor mechanical errors occasioned by small flexures in some components of our 2-meter curved crystal $\gamma$-ray spectrometer were discovered recently through comparison of wavelength measurements in different orders of reflection. These errors and the means adopted for their correction have been described in published papers and a program of redeterminations of nuclear $\gamma$ and x-ray wavelengths is underway. In this program, a by-product of the study of the radioisotope $Ta^{182}$ has led to measurements of the tungsten K-series x-ray lines, since tungsten is the daughter product of $\beta$ decay of $Ta^{182}$. In this way we have obtained the following results: W-K $\alpha_2$ = 213.387 ± 0.010; W-K$\alpha_1$ = 208.575 ± 0.008; W-K$\beta_3$ = 184.785 ± 0.027; W-K$\beta_1$ = 183.997 ± 0.019 all expressed in x.u. (Siegbahn). The agreement with other measurements, particularly those given in E. Ingelstam's dissertation (1937), is now well within the estimated standard deviation of our measurements, and to avoid further confusion (because our earlier values disagreed slightly from Ingelstam's) we wish to announce that our earlier results [published in Phys. Rev. 75, 505 (1949)] are herewith superseded by these present ones. (auth)

## *THEORETICAL PHYSICS*

**6598**

INTERNAL CONVERSION OF THE RADIATION OF A MAGNETIC MULTIPOLE. (Vnutrennaya Konversiya Izlucheniya Magnitroco Multipolya). V. B. Berestetskii. Translated by G. Belkov from Zhur. Eksptl'. i Teoret. Fiz. 18, 1057-69(1948). 28p. (TT-255)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 4-1316.

**6599**

THE ANGULAR CORRELATION IN THE INTERNAL CONVERSION OF $\gamma$-RAYS. (Uglovaya Korrelyatsiya Pri Vnutrennei Konversii $\gamma$-Luchei). V. B. Berestetskii. Translated by G. Belkov from Zhur. Eksptl'. i Teoret. Fiz. 18, 1070-80(1948). 22p. (TT-256)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 4-1308.

**6600**

THE RELATIVISTIC THEORY OF SPIN. (Relyativistskaya Teoriya Spina). Yu. M. Shirokov. Translated by E. Rabkin from Zhur. Eksptl'. i Teoret. Fiz. 21, 748-60(1951). 32p. (TT-276)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 6-457.

**6601**

RELATIVISTIC THEORY OF FREE PARTICLES HAVING THREE-DIMENSIONAL EXTENSION. (Relyativistskaya Teoriya Svobodnykh Trekhmerno Protyazhennykh Chastits). Yu. M. Shirokov. Translated by G. Belkov from Zhur. Eksptl'. i Teoret. Fiz. 22, 539-43(1952). 8p. (TT-441)

It is shown that the requirement of relativistic invariance does not introduce difficulties of principle in the theory of free particles having three-dimensional extension. A general method for constructing such a particle model is given. (K.S.)

**6602**

ON THE QUESTION OF DIPOLE TRANSITIONS IN NUCLEAR PHOTOEFFECTS. Yu. K. Khokhlov. Doklady Akad. Nauk S.S.S.R. 97, 239-42(1954) July 11. (In Russian).

The diminsions of $\langle D_z^2 \rangle$ in the fundamental model of independent particles in a quadratic potential well were calculated. (J.S.R.)

**6603**

ANALYSIS OF NUCLEAR PERIODICITY BY MEANS OF A STABILITY CURVE. N. N. Kolesnikov. Doklady Akad. Nauk S.S.S.R. 97, 233-6(1954) July 11. (In Russian).

**6604**

QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. M. Gell-Mann and F. E. Low (Univ. of Illinois, Urbana). Phys. Rev. 95, 1300-12(1954) Sept. 1.

The renormalized propagation functions $D_{FC}$ and $S_{FC}$ for photons and electrons, respectively, are investigated for momenta much greater than the mass of the electron. It is found that in this region the individual terms of the perturbation series to all orders in the coupling constant take on very simple asymptotic forms. An attempt to sum the entire series is only partially successful. It is found that the series satisfy certain functional equations by virtue of the renormalizability of the theory. If photon self-energy parts are omitted from the series, so that $D_{FC} = D_F$, then $S_{FC}$ has asymptotic form $A[p^2/m^2]^n[i\gamma p]^{-1}$, where $A = A(e_1^2)$ and $n = n(e_1^2)$. When all diagrams are included, less specific results are found. One conclusion is that the shape of the charge distribution surrounding a test charge in the vacuum does not, at small distances, depend on the coupling constant except through a scale factor. The behavior of the propagation functions for large momenta is related to the magnitude of the renormalization constants in the theory. Thus it is shown that the unrenormalized coupling constant $e_0^2/4\pi\hbar c$, which appears in perturbation theory as a power series in the renormalized coupling constant $e_1^2/4\pi\hbar c$ with divergent coefficients, may behave in either of two ways: (a) It may really be infinite as perturbation theory indicates; (b) It may be a finite number independent of $e_1^2/4\pi\hbar c$. (auth)

**6605**

MATRIX ELEMENT AND INTEGRAL FOR THE SHELL MODEL OF LIGHT NUCLEI. A. Florian and P. Urban (Univ. of Graz, Austria). Acta Phys. Austriaca 8, 338-45(1954) July. (In German).

In order to find the approximate energy eigenvalue of the nuclear state, the value of the true nuclear force and Coulomb force must be calculated. The value of the interaction energy in the closed 1s and 2p shell, derived from specific nuclear force and electrostatic repulsion, and the effects of these shells on a single nucleon in another state are shown. A number of integrals are given to which these and other matrix elements can be reduced. (tr-auth)

**6606**

WAVE FUNCTIONS OF THE ELECTRON WITHIN NUCLEI III. APPLICATION TO THE $\beta$ SPECTRUM OF RaE. Roger Nataf. Compt. rend. 239, 341-4(1954) July 26. (In French). (cf. NSA 8-3608 and 8-3485)

The nonzero ray of the nucleus has two effects on the form of the $\beta$ spectrum. It modifies the values of the wave functions at the surface of nucleus, and the variations of these functions within the nucleus contributes to these corrections. (tr-auth)